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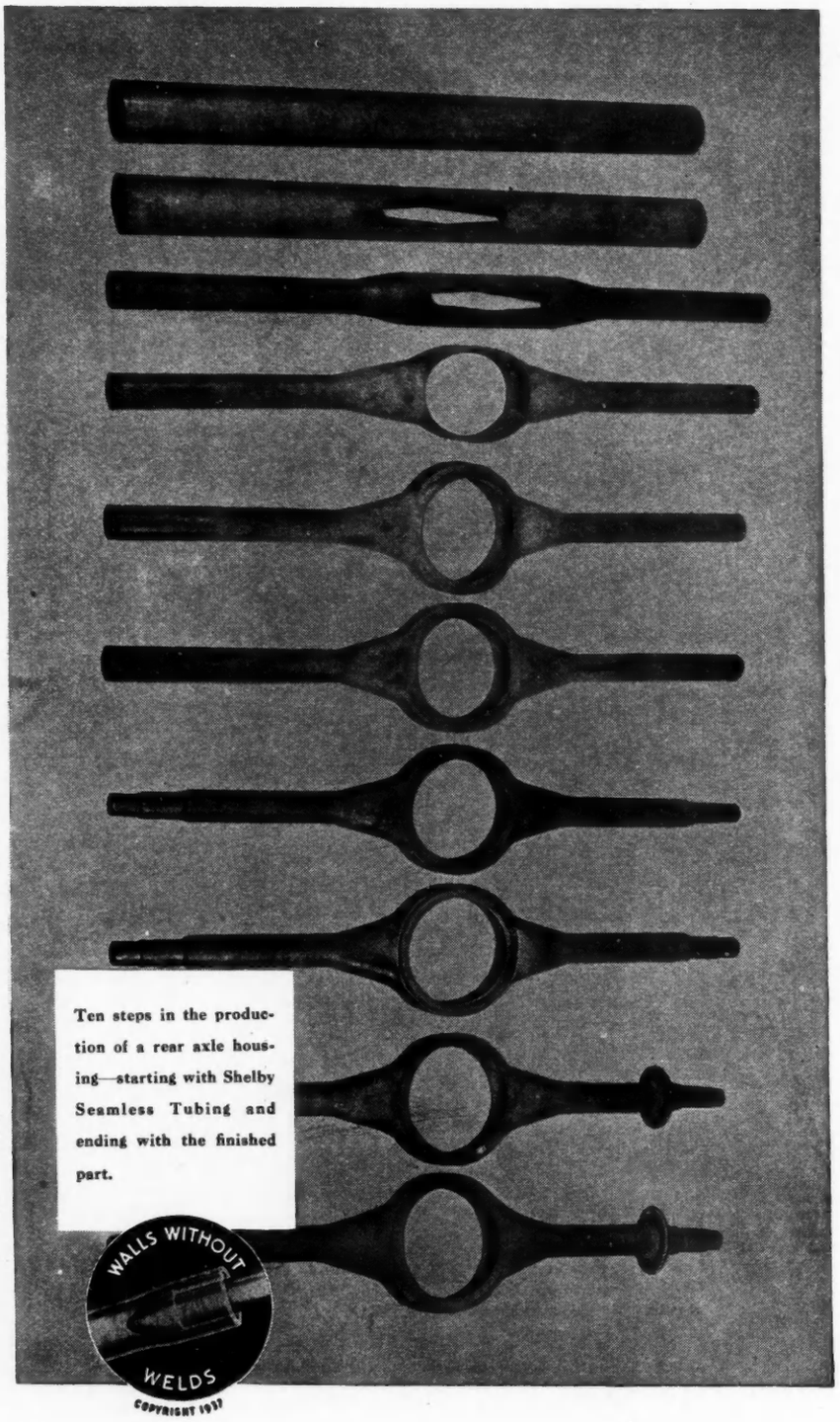
THE RIGHT START for successful parts



Ten steps in the production of a rear axle housing—starting with Shelby Seamless Tubing and ending with the finished part.

...begin with SHELBY TUBING

FRONT and rear axles, housings, drag links, tie rods, torque tubes, brake cross shafts, body and seat framework — leading automotive manufacturers make these parts from SHELBY. And here's the reason why.

Automotive engineers *know* SHELBY from the inside out. Many of them have worked with it, built with it, designed with it. They have seen it perform in the machine shop, on the production line, and finally in service. They know that SHELBY has what it takes for automotive parts.

Their confidence in SHELBY is well placed. Selected steels, expert metallurgical supervision, control of manufacture from ore to finished tubing, rigid inspection and tests in every stage of production — these factors insure its thorough uniformity, ductility, and strength. That is why the name SHELBY stands for tubing of distinction . . . why you are right from the start when you begin with SHELBY.

SHELBY is available in round, square, rectangular, oval, and other shapes — all practical sizes, lengths, and wall thicknesses—various finishes and many grades of carbon and alloy steels. SHELBY can also be furnished in special forms and shapes—literally "Tailor-made" to your specifications —to speed up production and cut finishing costs.

Whenever you are considering changes in designs, send us your drawings and specifications. Our engineers are specialists in tubular construction. Their recommendations frequently result in better parts at lower costs.

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UNITED STATES STEEL

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AUTOMOTIVE INDUSTRIES

July 24, 1937
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Steady Demand Sustains Production

Current Buying Stimulated by Rumors of Price Rise on '38 Models; Truck Output Also Fairly Heavy

Demand for new automobiles is holding up unexpectedly well. There are three reasons for the late summer strength of the retail market. The public has the impression, probably well founded, that 1938 cars will be somewhat higher in price and not much different from the present models. This is leading to current buying in considerable volume. A second reason is the promise of very fine crops. Reports from agricultural areas indicate the sale of a sizable number of new cars, many on clean, cash deals, and by no means all low-priced models. The third reason is the cessation of labor troubles in many centers. Deferred car purchasers are now being made.

As a result, numerous manufacturers are prepared to continue with 1937 model production until at least mid-August. It might have been supposed that car companies would be just as well pleased to taper off now and plan on substantial early sales of 1938 models, the prices on which will probably tend to offset the rise in costs. However, plant executives say "we are taking our sales when we find them" and are not risking losing business now for possible 1938 model-year gains.

There is not much difference this week from last in the industry's production excepting for the dent in the over-all figures that results from the Ford inventory shutdown. Based on about 6000 assemblies a day, the Ford closure will make a difference of between 20,000 and 25,000 units in the industry's total for the week. Should the seasonal slowing down at some other plants turn out to have been more marked than was originally indicated, total production for the week might lose over 25,000 units.

Some interference with shipments was reported late last week due to a freight car shortage. The condition has been remedied. It was traceable in part to the trucking strike which led to a rush for freight cars. Increased driveaways and the appearance of more freight cars eased the situation where it occurred and shipments are again closely following production.

Truck production is continuing to run at a fairly high rate. As with passenger cars, early forecasts are being topped. The truck plants are not so crowded with business as they were earlier in the year, however, and some can now operate both light and heavy assembly lines. Orders have turned upward again recently after an early summer letdown but the plants feel a slackening is to be expected in August. The business is well scattered as to source.

(Turn to page 111, please)

This Week

NEWS brings announcement of Studebaker Diesel-powered truck . . . also Graham-Bradley tractor . . . Knudsen reiterates GM stand on UAW . . . scheduling of GM-FTC hearings . . . two views as to what the future holds for the automobile . . . Cameron's blast at NLRB and the newspapers.

FEATURES include pointers on piston-pin design . . . description of research at the M.I.T. laboratory . . . a well-known engineer discusses several elements of vehicle performance . . . details on newer bearing materials, their composition and lubrication . . . two-stroke engine investigations . . . data on a new two-engined racing car . . . mechanical drawings of the Peugeot passenger car engine.

Knudsen Reiterates GM Stand on UAW

Tells Union That Company Must Be Assured Against Unauthorized Strikes Before Any Changes In Contract Can Be Negotiated

General Motors Corp. informed the United Automobile Workers, in a letter dated July 20 from William S. Knudsen, president of GM, to Homer Martin, president of the UAW, that the company is standing its ground on the matter of requiring specific assurance against unauthorized strikes before the company will negotiate any other changes in its contract with the union.

Mr. Knudsen's letter was in answer to one from Mr. Martin which claimed that in order to successfully prevent such strikes, it would be necessary to eliminate their cause. Mr. Martin said the union is doing all it can to prevent "wildcat" strikes and will intensify its efforts, but stated that a faulty grievance procedure was the reason for the strikes. He asked a revision of the practice in this respect.

Mr. Knudsen declared in his answering letter that in no case had the union exhausted the grievance procedure set up and that in many cases, strikes were called before the management was aware that grievances had arisen. He also said that the shop committee arrangement provided had worked well, answering Mr. Martin's complaint that a shop steward system was needed. Mr. Knudsen repeated the form of a stipulation covering the matter of responsibility for unauthorized strikes as originally suggested in his statement to the union on June 23.

Mr. Knudsen's Letter

Mr. Homer Martin, President
International Union
United Automobile Workers
of America
Detroit, Michigan — July 20, 1937

Dear Sir:

This is in reply to your letter of July 13. The main point of that letter is your claim that the reason the Union has violated the provision in our agreement which prohibited stoppages until the grievance procedure had been exhausted, is that the grievance procedure itself is not satisfactory.

In none of the over two hundred cases in which a strike occurred, did your organization follow the grievance procedure to a con-

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Graham Announces Tractor

To Be Manufactured on Separate Assembly Lines and Marketed Principally Through Sears, Roebuck and Co. Outlets

Announcement has been made by Graham Paige Motors Corp., Detroit, of the new Graham-Bradley tractor which the company will manufacture on a separate assembly line in its own plant and market principally through Sears, Roebuck and Co.'s retail stores in seven farm states of the mid-west. The tractor is designed to handle the various farm implements made by the David Bradley Mfg. Works, Sears subsidiary.

Until production can be increased beyond the 25 units per day which is scheduled at present, distribution will be held within the restricted limits prescribed. However, in the plans for the future there is provision for marketing the tractors through the national network of Sears stores, and in addition Graham will make independent arrangements for the handling of the tractors in points where Sears has no outlets.

Prices were not announced at the formal preview and demonstration which was held July 13 and 14 at the Graham farms, Washington, Indiana. It was said that this announcement would come later through Sears Roebuck.

The Graham Bradley tractor is engineered for pneumatic tire equipment and it is said that it will pull a two or three 14-in. bottom plow at 6.2 m.p.h. through any soil in high gear. In fourth speed it can move along the highway at 25 m.p.h. Other working speeds are 4.4 m.p.h. in second gear and 2.8 m.p.h. in low.

It is equipped with an automobile-type cushioned seat with back rest; self starter; swiveled lights mounted on the rear fenders for night work; platform and complete automotive-type ignition with battery and generator.

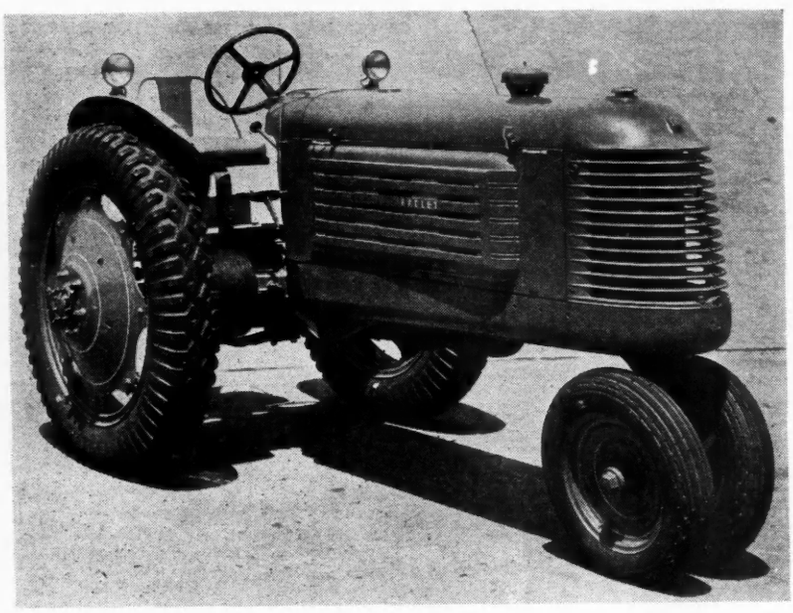
The engine, a 6-cylinder, L-head type, develops 35 hp. at 1400 r.p.m.; has full pressure lubrication to all main and connecting rod bearings, pistons, timing chain and camshaft bearings; a "straight through" type muffler identical to automobile practice; gas and oil filters, air cleaner; and many other features.

The four speeds forward and one reverse permit such farm implements as threshers, corn shellers, water pumps, burr grinders, etc., to be operated at their most efficient speeds. The reverse gear is a decided advantage when corn shellers or threshers become clogged, for the belt can be reversed by power.

Rear tires are 36 by 9.00 pneumatics, carrying 28 lb. of air pressure and, if needed for extra traction, 250 lb. of water. Front tires are 16 by 5.50.

Power take-off is located according to standard practice and uses a standard size 1⅜ in. six-spline shaft which has a separate throwout clutch with which the unit can be disengaged when not in use.

The tractor is five feet high, has a wheelbase of 90 in., and can make a complete turn within a radius of its own length. Complete technical details of the new unit will be published in AUTOMOTIVE INDUSTRIES, July 31.



NEW TRACTOR known as the Graham-Bradley which has been announced by Graham Paige Motors Corp. and is to be marketed principally through Sears, Roebuck and Co.'s retail stores. Designed to accommodate farm implements made by the David Bradley Mfg. Works, Sears subsidiary, the new unit is said to be capable of pulling a two or three 14-in. bottom plow at 6.2 m.p.h. through any soil in high gear. The power plant is a 6-cyl., L-head type engine which develops 35 hp. at 1400 r.p.m.

W. J. DAVIDSON
. . . was recently appointed General Sales Manager of the Winton Engine Corp.

W. J. Davidson Joins Winton

Former G.M. Technical Director Made General Sales Manager

New general sales manager of Winton Engine Corp., Cleveland, Ohio, is William J. Davidson, formerly technical director under R. H. Grant, vice-president of General Motors Corp. in charge of sales. Mr. Davidson first became associated with General Motors in 1914 when he joined the engineering department of the Cadillac Motor Car Co. He has been with G.M. almost continuously since that time, with the exception of the period of his World War service.

He served in France with the Motor Transport Corps, being discharged with rank of Captain in 1919. In 1934 Mr. Davidson was awarded the Cross of the Legion of Honor by France in recognition of his war service and of cooperation with French engineers since the war.

Upon his return from France he was made chief engineer of the Canadian Products Div. of General Motors at Walkerville, Canada. From here he went to Oshawa, Canada, to take up new duties as technical director of General Motors of Canada, Ltd.

Promotion to the staff, at Detroit, of Alfred P. Sloan, Jr., then president of General Motors Corp., came in 1923 and Mr. Davidson was made executive secretary of the General Technical Committee. Three years later he was also made executive secretary of G.M.'s newly formed New Devices Committee. In 1930 he was made business director of the research laboratory.

Fiat Makes 3rd Edition

New "Balilla" Line Has 4-Cyl. Engine Which Develops 32 B. HP. at 4000 r.p.m.

The third edition of the "Balilla," spearhead of the Fiat line of cars, has been announced in Italy. The new line carries a four-cylinder engine of 68 mm. (2.68 in.) bore and 75 mm. (2.95 in.) stroke, effecting a total piston displacement of 1090 cc. (66.5 cu. in.); it develops 32 b.hp. at 4000 r.p.m. using a compression ratio of 6 to 1.

Cylinder block is of phosphor-manganese iron, cast integral with the base of the combustion chamber. Cylinder head is aluminum with inserted valve seats. Fuel consumption of 32 m.p.g. is claimed, with Zenith or Solex downdraft carburetion optional.

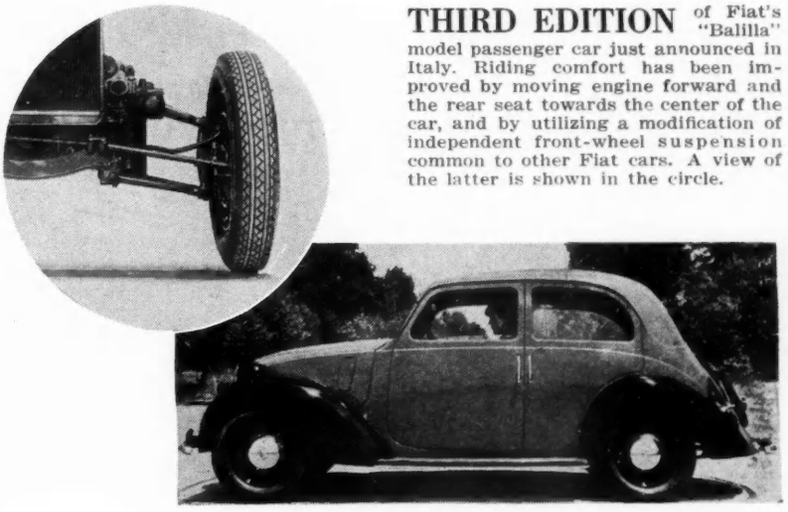
Brake drums on the new car have an outer ring of ribbed aluminum with an inner ring of cast iron. Service brakes are pedal-actuated hydraulic, and the hand brake acts on the transmission.

Riding comfort of the new car has been improved by moving the engine forward, moving the rear seat toward the center of the car, and incorporating a modification of the independent front-wheel suspension system used on the larger and smaller Fiat cars.

In the "new Balilla" the front suspension, with independent wheels, is attained by means of two joined parallelograms arranged crosswise as in the smaller Fiat,* but with the difference that, owing to the greater size and weight of the new car, the upper arm consists of an articulated lever instead of a leaf spring. The shape of the unequal sided rhomboid ensures constancy of the wheel track during oscillations. There are two coiled springs, one main and one auxiliary, working in oil in a large vertical casing which also houses the double acting hydraulic shock absorbers. This casing is anchored to the frame and forms the fixed vertical side of the parallelogram. At its upper end, at the side, is articulated the guide lever of the parallelogram which, oscillating, acts on the springs.

The steering has also been altered in conformity with the new constructive features of the front train. From the single steering box, with worm and worm wheel, fitted with a device for taking up backlash, two separate steering drag links are actuated, which control the two front wheels separately.

*See AUTOMOTIVE INDUSTRIES, Aug. 15, 1936, p. 223.



THIRD EDITION of Fiat's "Balilla" model passenger car just announced in Italy. Riding comfort has been improved by moving engine forward and the rear seat towards the center of the car, and by utilizing a modification of independent front-wheel suspension common to other Fiat cars. A view of the latter is shown in the circle.

June Rim Inspections Up 14%

Total number of rims inspected and approved by the Tire and Rim Association, Inc., is placed at 2,141,810 for the month of June, an increase of more than 14 per cent over last year's June figure of 1,876,446.

In the first six months of 1937 a total of 12,913,191 rims were inspected and approved. Compared with the total for the same six months a year ago of 11,072,928, the increase amounts to about 16.5 per cent.

Beyond the Near Future

National Resources Committee Expects No Radical Metamorphosis In Automobile; But to C. F. Kettering "The Future Will Demand Change"

Possibilities of revolutionary changes in social and economic life by new inventions are dealt with in a 388-page study on "Technological Trends and National Policy" by the National Resources Committee but for the automobile, unlike many other modern developments discussed, the committee does not see any sweeping change. The automobile, it is suggested, will remain about the same size as at present. For the little car the committee predicts but little for the future because it is not comfortable. Automobiles will be lighter because of development of light metal alloys. While automobiles can be made faster through such devices as streamlining, the committee thinks they are fast enough already and that there will be reaction against traveling at breakneck speeds. At present there is about one car for every five persons. The ultimate limit in the United States may be a car for everybody.

The committee sees the prospect of an increase in trailers, with trailer stores, perhaps seriously affecting mail order houses and department stores and the old pack peddler may stage a comeback. The rise in the trailer population is pictured because they make possible a roaming existence of following seasons and employment. Trailers also are declared to tend to break up the stability of communities, affect the housing problem and cause a serious educational problem.

For aviation the committee sees far reaching possibilities — even probabilities. The "steep flight" aircraft is said to be near, resting on development of the socalled "roof hopper," which can go straight up, hover in the air and come straight down at slow speed, such as is now represented by the helicopter and autogyro. Suburbanites could fly to their place of business, dropping on office roofs, and forget parking and traffic worries.

The report, by nationally known scientists and sociologists, was made to the President, and proposes a planning board to protect employment for millions who, it is indicated, might be made idle through replacement by technological developments. The Committee is headed by Dr. William F. Ogburn, University of Chicago.

In contrast with some of the opinions ventured by the National Resource Committee's report are the speculations of Charles F. Kettering, vice-president of General Motors in charge of research, in his address before the American Society of Civil Engineers in Detroit on July 21. Speaking on the subject "Motor Vehicles and Highways of the Future," Mr. Kettering predicted that "the car of ten or twenty-five years from now will be just as different and have just as many improvements as it has in the past ten or twenty-five years."

G.M.'s research chief based much of his talk on answers to eighteen questions he sent to a large number of persons associated with automotive and allied industries.

"Accelerations," said Mr. Kettering, "will probably increase. It now appears that any passenger car will be able to negotiate a 10 per cent grade without losing its speed. Undoubtedly, the trend is for the performance of trucks and buses to more nearly equal that of passenger cars.

"The ability to stop is of major importance. I'm sure the automobile industry will offer better and better brake equipment as they learn more and more

(Turn to page 133, please)

GM-FTC Hearings Scheduled

Company Denies All Charges of Unfair Dealer Practices; Defense Expected to Cite Contract Terms

Hearings on the Federal Trade Commission exclusive dealer complaint against the General Motors Corp., and General Motors Sales Corp., have been scheduled to begin in Detroit next Monday, July 26, where they will be held in the Federal building. They will be extensive. The tentative schedule lists hearings in midwest cities into September. After three days in Detroit hearings will be transferred to Chicago beginning July 29 in the new Post Office Building. Among other cities listed are Milwaukee and Kansas City. Dealers will be called as witnesses. The hearings are in charge of Trial Examiner John L. Hornor while Everett Haycraft will appear as counsel for the F.T.C.

In their answers making a denial of all the F.T.C.'s charges the G.M. and G.M.S.C. declare that the terms and legal effects of the dealer agreements of G.M. subsidiaries for the resale of automobiles, parts, supplies and accessories are not correctly, not fully and not fairly stated in the complaint. Correctly and fairly stated, the replies point out, the agreements do not constitute violation of Sec. 3, of the Clayton Act, which prohibits exclusive dealing contracts or of Sec. 5 of the Federal Trade Commission Act, which prohibits unfair competition.

The answers are not detailed. They take the form of denying charges in each paragraph of the complaint without attempting any analysis of the latter, evidently leaving to the hearings the matter of presenting evidence to report in detail each specific charge.

The principal unfair practices alleged by the F.T.C. are the use of intimidation, oppression and coercion to compel dealers handling General Motors cars, against their will, to purchase parts, accessories, and supplies for use on such cars only from General Motors subsidiaries or affiliates.

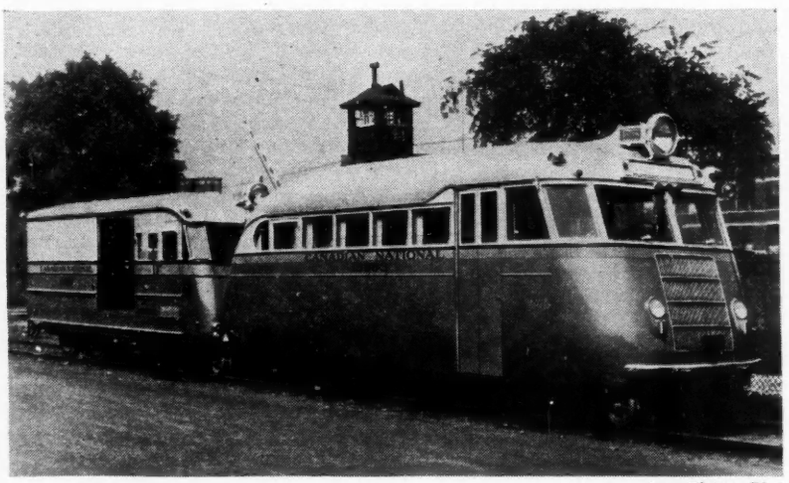
Basis of the defense of the General Motors Corp. against Federal Trade Commission charges of unfair competition and practices tending to create monopoly in the sale of parts and accessories to dealers is expected to include presentation of the terms of contracts between dealers and the company's divisions. The contracts do not require the dealers to take accessories, but do include agreements that dealers will maintain such stocks of repair and replacement parts as are adequate to service the number of cars of the particular make in the dealer's area.

Substance of the Federal Trade Commission's charge is that the dealers have been coerced into taking unordered parts and accessories, thus making it more difficult for independent manufacturers of similar items from having a full opportunity to sell to the dealers in question.

The contracts are said now to be, and to have been in the past, liberal in the provisions covering return by dealers of unwanted parts. It is said that the company takes back from dealers under certain conditions parts which may be unsold at the end of a model year or whenever any other change may be made in the parts, and that it also takes back parts from dealers who may go out of business. The company is expected to defend its right to require dealers to carry and supply only genuine repair and replacement parts for its cars.

So far as the limiting of competition among manufacturers of accessories is concerned, it is pointed out that whenever a General Motors accessory is designed for a General Motors car, there must logically follow some limitation on those who would manufacture and sell for General Motors cars other accessories of similar general nature.

Explanation of the quantity of accessories sold to dealers by the company is said to lie in the fact that dealers have been able to expand their total sales considerably by the handling of the accessories. This has been particularly true this year with strike-caused shortages of new cars. Dealers have attempted to sell cars carrying a variety of accessories in an effort to make some money. The company will take the position that the dealers themselves ordered the accessories without any coercion on the part of the company.



Acme Pictures Photo

AT HOME on rails or roads this freight and passenger unit of the Canadian National Railways combines advantages of bus, truck and rail transportation to facilitate delivery of freight and passengers nearer to their destinations. Each vehicle is equipped with automobile and standard gage railroad wheels. Cars may be hitched to travel as a unit, or operated individually under their own power.

Bantam Ready

R. S. Evans Says Co. Fully Financed; Plan Production in September

R. S. Evans, president of American Bantam Car Co., Pittsburgh, has reported that of 90,000 shares of stock which were originally offered in the new company, 85,000 shares have been sold and the remaining 5000 shares withdrawn from the market.

Mr. Evans stated that the company is now fully financed for production, has assets in excess of $1,500,000, of which one-third is in cash; and is free of all indebtedness except current liabilities of less than $15,000.

"During the past six months, while the company was being financed," said Mr. Evans, "engineering and designing for the new line of trucks and passenger cars was completed, commitments made and orders placed for materials. Production is scheduled for September."

Initial production of the American Bantam Car Co. will consist of quarter-ton chassis, panel and pick-up trucks, coupes and roadsters.

Performance claims for the American Bantam include the fact that the car will go up to 60 m.p.g. of gasoline, will attain a speed in excess of 60 m.p.h., and can be operated for less than three-quarters of a cent for gasoline, oil and tires.

The American Bantam Car Co. purchased the properties of the former Austin Car Co. last summer. The plant was originally equipped in 1930 and has a capacity of 40,000 cars a year.

William C. Stettinius

William Carrington Stettinius, former president of the American Hammered Piston Ring Co., and of the National Standard Parts Association, died July 20 in Baltimore, at the age of 41. Long active in automotive trade association work, Mr. Stettinius entered

business from the financial side, representing various bankers and brokers as director of a string of companies. A son of the late Edward R. Stettinius, Morgan partner, he is survived by a brother, Edward R. Stettinius, Jr., chairman of the finance committee of the U. S. Steel, and a former vice-president of General Motors.

Form Racing Corp.

Bowes Racing, Inc., Will Build Car To Meet Foreign Competition

Announcement has been made of the formation of Bowes Racing, Inc., a new corporation with the sole purpose of building a racing vehicle capable of competing on an even basis with the German and Italian cars which have dominated the Vanderbilt Cup races for the past two years. "Lou" Meyer of Huntington Park, Calif., and Robert M. Bowes, president of the Bowes Seal Fast Corp. of Indianapolis, form the personnel of the new organization.

Meyer will have complete charge of building the proposed speedster and has already departed for Los Angeles to get construction work under way. The new car will cost more than $15,000 and will be built to comply with the new international racing rules which will go into effect in this country next year.

According to present plans, the body of the car will incorporate latest principles of streamlining to cut down wind resistance and add to the car's speed possibilities. Many imported parts will be required for the engine, including a foreign-built supercharger, it is said.

Studebaker Offers Diesel Truck

New Model Powered With 6-Cylinder Hercules Engine; Chassis Designed for 9, 12, and 15-Ft. Bodies

C. H. Wondries, director of Sales Truck Div. of the Studebaker Corp., has announced the introduction of a special Studebaker Diesel-powered truck known as model J20D. The chassis is designed for 9, 12, and 15-ft. bodies with 138, 162, and 180-in. wheelbase dimensions. Prices at the factory are listed as $2,450, $2,500, and $2,550, respectively.

The new truck is powered by a six-cylinder Hercules engine, model DJXB, with bore and stroke dimensions of 3½ in. by 4½ in., giving a piston displacement of 260 cu. in. Torque rating is 174 lb.-ft. at 1200 r.p.m. Gross vehicle rating of the J20D is 15,000 lb., 1000 lb. greater than the model J20 gasoline powered truck of two to three ton rating.

Rear axle is of two-speed, full floating design, with a standard gear ratio of 7.62, slow, and 5.57 fast; front axle is of the Reverse Elliott type.

A single plate, dry disc clutch with woven molded facings and a ball release bearing is furnished. Needle roller bearings are provided in the universal joints. Fuel tank of 30-gal capacity is provided at the left side of the frame. A standard vacuum governor set at 2600 r.p.m. and a wet type of air cleaner are provided.

A current voltage generator regulator is provided for the 12-volt generator and lighting system. A heavy-duty 24-volt starting motor, with solenoid control, is powered by the four, 24-volt batteries, of 17-plate design. The ampere capacity of each battery is 136 hrs.

The fuel tank has a capacity of 30 gal. and is mounted at the left side of the frame. A standard vacuum governor set at 2600 r.p.m., and wet type air cleaner are provided.

A tubular radiator core with a radiator frontal area of 517 sq. in., centrifugal water pump, has a 20-quart capacity. It has a full-length water jacket and is provided with a thermostat. Cast steel spoke wheels are standard equipment, but disc wheels may be had. Cam and lever type of steering gear, with an 18 to 1 ratio is provided. The steering wheel has a 20-in. diameter.

Silico-manganese semi-elliptic springs, 39 by 2½ in., with nine leaves are mounted on the front axle; springs of the same material, 54 by 3 in., with 13 leaves, and auxiliary springs 36 by 3 in. with nine leaves on the rear. Lockheed hydraulic brakes are supplied which provide a total effective brake area of 320½ sq. in. The emergency brake is of the transmission band type, with 87 sq. in. total effective area. Emergency brakes at the rear wheels may be had at extra cost.

Cameron Flays NLRB and the Press

Raps Newspapers for Editorializing News, Failure to Report All Facts, and Making "Undeserved Hero Out of John L. Lewis."

Sharply worded criticism of the way the NLRB is handling the Ford Wagner Act case and of the way politics has been allowed to enter industrial affairs was voiced in Detroit on July 21 by W. J. Cameron of the Ford Motor Co., addressing a meeting of the National Editorial Association there.

Mr. Cameron also assailed the press for editorializing in the news, for failure to report all the facts and for making "an undeserved hero out of John L. Lewis." Mr. Cameron stated that thousands of men were coerced into union membership and declared no newspaper had printed that. He added that the newspapers have been swayed by public opinion and when the public sentiment started to swing away from the CIO, the papers changed their attitude.

On the matter of the Wagner Act and the NLRB, Mr. Cameron remarked in passing that the May 26 riot at the Ford Rouge factory was conceived by the CIO "to stick a label on the Ford Motor Co. with the purpose of making the public believe that Henry Ford is the very worst of all industrial managers." He charged that the news and pictures of the event played directly into the hands of "those who planned it for that specific purpose."

Mr. Cameron attacked the misuse of the press by public officials as a "legal lynching" of the name of the company. He said the law sets up traveling courts of inquisition which make charges that "often read like stump speeches from a Socialist or Communist platform."

"These traveling courts, one of which is sitting in Detroit today, sit as judge, jury, prosecutor, witness and hangman on their own charges. They find their own verdict and that verdict is heralded throughout the land by the press to the injury of public confidence in and the reputation of the business.

"When later in the real courts of the land —and we still have some real courts—the accused business succeeds by fair and legal means in disproving the charges, what does it matter? The clearing may get four lines and a half. The punitive political purpose has been accomplished."

Employment Tops '29

More men have been employed in the automobile manufacturing industry during 1937 than in any preceding year, including 1929 when the peak of production occurred, reports the AMA.

The average employment for the first eight months of 1937 production was 522,000 men compared to 463,000 during the same period of 1936. Average weekly payroll was $15,885,000 against $12,461,000 last year.

The previous employment record for the first eight months of 1929 was 489,000 or 6 per cent below the current season's level. The payroll averaged $15,785,000. Production in 1929 started in January.

United Specialties Adds to Earnings Capacity

At a special meeting of the stockholders of United Specialties Co. held July 19, 1937 at the Detroit offices of the Co., the purchase of an 80 per cent interest in the Alco Valve Co. of St. Louis was ratified.

Col. Fred Glover will represent the United Specialties Co. on the Board of Directors of the Alco Valve Co.

Stockholders also ratified an amendment increasing the authorized common stock from 207,375 shares to 250,000 shares and authorized the issuance of 25,000 shares of $1.40 cumulative convertible preferred stock. (No par.)

Carboloy Co., Inc., Detroit, has bought the entire cemented carbide interests formerly controlled by the Union Wire Die Corp. The purchase unites the two largest suppliers of the cutting metal. Existing channels of sales and service will be continued under the new arrangement.

Business in Brief

Written by the Guaranty Trust Co., New York

General business activity declined sharply during the week ended July 10. The business index compiled by the "Journal of Commerce" stood at 92.1, as compared with 99.4 the week before and 89.3 for the corresponding period last year. The fall in the index was mostly the result of the Independence Day holiday. The Government's July crop report indicates normal yields for most important crops, and this prospect is expected to stimulate retail trade.

Rail Loadings Down

Railway freight loadings during the week ended July 10 totaled 682,295 cars, which marks a decrease of 123,963 cars below those in the preceding week, a decline of 42,072 cars below those a year ago, but an increase of 116,703 cars above those two years ago.

Production of electricity by the electric light and power industry in the United States during the week ended July 10 was 7.2 per cent above that in the corresponding period last year.

The adjusted index of department store sales compiled by the Board of Governors of the Federal Reserve System for June stood at 93, which is the same as the figure for both May and April, and compares with 87 for the corresponding period last year.

Construction contracts awarded in June in 37 eastern states, according to the F. W. Dodge Corp., amounted to $318,137,100, which marks an increase of 30 per cent above those in the preceding month and a rise of 37 per cent above those in the corresponding period last year.

The cost of living of wage earners in June increased 0.1 per cent. A decline in food prices was offset by a rise in the cost of clothing and rents. The current index, however, is 4.5 per cent higher than that a year ago.

Lumber production during the week ended July 3 stood at 70 per cent of the 1929 weekly average. The week's production was 12 per cent greater than new business and 4 per cent below shipments.

Fisher's Index Drops Slightly

Professor Fisher's index of wholesale commodity prices for the week ended July 17 stood at 92.5, as compared with 92.9 the week before and 92.5 two weeks before.

The consolidated statement of the Federal Reserve banks for the week ended July 14 showed an increase of $2,000,000 in holdings of discounted bills. Bills bought in the open market and Government securities remained unchanged. Money in circulation declined $67,000,000, and the monetary gold stock increased $47,000,000.

A new folder has been issued by the Bethlehem Steel Co. describing its **silico-manganese spring steel.***

Functions of the Traffic Manager is the title of a report recently issued in pamphlet form by the Policyholders Service Bureau of the Metropolitan Life Insurance Co.*

The Waukesha Motor Co., Waukesha, Wis., has brought out the first issue of its new company publication called the Waukesha Engineering Record.*

A bulletin describing the use of Landis **thread cutting equipment** for railroad shops has been issued by the Landis Machine Co., Waynesboro, Pa.*

The U. S. Department of Agriculture has just published a bibliography, designated as Miscellaneous Publication No. 279, on **highway lighting.** It covers, primarily, the years 1913 to 1936 and emphasizes recent developments.

A new folder on **ground shafting** has been prepared by Bliss & Laughlin, Inc., Buffalo, N. Y.*

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

Atlantic Tests Fuels on the Road

This week the Atlantic Refining Co. inaugurated a series of road tests to augment a research program, concerned principally with investigations of the anti-knock quality of fuels, which has been under way in its laboratories for many months. It is planned to test experimental fuels on the road under conditions ranging from mild to very severe conditions encountered in city and cross country driving.

Ten cars, representing most of those in general use, will be driven over a section of road near Lewistown, Pa. Each car will carry a driver and trained observer who will note performance of gasolines under test. Technique employed will be to match test fuels against standard reference fuels of known laboratory performance.

The road tests are scheduled for a period of seven weeks and will be repeated later in the year in order that comparative data may be obtained for cold weather driving conditions.

Pontiac Extends Apprentice Training Facilities

So that a larger supply of adequately trained young men may be available for the specialized work of automobile manufacture, a new course in apprentice training is to be started this fall by the Pontiac Motor Div. of General Motors, according to an announcement by H. J. Klingler, general manager.

A separate building to house the school, a structure of brick, steel and glass with a floor area of 10,044 sq. ft. is already erected and is now being equipped with a complete heat treat installation, drill presses, bench lathes, seven grinders, screw machines, ten milling machines including boring mill and vertical shaper, ten lathes, and complete pattern shop.

Tentative plans call for gradual admission of new students until the full quota of 50 is reached. Thereafter new students will be admitted only as old ones complete their training in order to avoid the temporary over-supply which would result from annual graduation of one class at a fixed date each year.

Briggs Abandons Motor Products Merger

Plans for the merger of the Briggs Mfg. Co. and the Motor Products Corp. have been abandoned, it was announced. Briggs Manufacturing plans to go forward with the building and equipping of plants in which will be made the products Briggs would have made in the Motor Products properties.

A letter to Briggs stockholders signed by Walter O. Briggs, chairman, and W. P. Brown, president, stated that Motor Products Corp. had informed the Briggs company that Motor Products had ceased efforts to secure proxies for a merger vote scheduled for July 22. Opposition from stockholders who objected to the merger terms of three shares of motor Products stock for two shares of Briggs stock was given as the reason. Briggs stockholders were therefore notified that no action will be taken at a special stockholders meeting scheduled for July 23 and that Briggs Manufacturing will proceed immediately to set up its own production facilities for the parts in question.

Fry Opposes UAW and Closes Plant

Walter L. Fry, president of Fry Products, Inc., Detroit, makers of automobile seat covers, closed his plant July 20 rather than recognize the UAW. Mr. Fry has for months been disputing the responsibility of the union as a bargaining body for his employes.

At a stormy meeting at the plant June 19, Mr. Fry nearly won the confidence of the workers gathered there, but subsequently lost the meeting to the union when a UAW organizer entered and took over. Mr. Fry stated that he had no objection to unions but simply considered the UAW unfit to act for his employes. He said he would negotiate with a committee of workers, but they finally insisted on having a UAW representative sit with the committee. To this Mr Fry objected.

. . . slants

CHINESE GO METRIC—*Regulations stipulating that gasoline gages used on all motor vehicles operating in China shall be calibrated to record quantities in liters instead of gallons and that speedometers shall register in terms of kilometers instead of miles were recently promulgated by the National Government, according to a report to the Department of Commerce from the American Trade Commissioner in Shanghai.*

The new regulations apply only to motor vehicles operating in Chinese territory and are not applicable to motor vehicles operating exclusively in foreign concessions at major treaty ports. All speed recording devices and signs are also to indicate in terms of kilometers instead of miles, and gasoline tanks and similar oil containers are to be marked in terms of liters instead of gallons.

Present owners of motor vehicles are allowed six months to change their gasoline gages and speedometers over to the metric system.

FOR THE TRAILERLESS . . . . *vacationers who have a yen to roam through*

Yellowstone, Grand Teton, and Glacier National Parks the Western Trailways Service has organized a trailer rental plan. Tourists will be able to drive in their own cars to the parks, stop at terminals, have trailer couplings installed on their cars and rent trailers to live in while following park trails.

Terminals of the company are located at or near the entrances to the parks and will serve not only as service points for rental trailers, but will be equipped as trailer parks for tourists traveling in their own trailers.

On completion of trips through the parks, the trailer may be unhooked at any terminal and left there. Western Trailways Service has ordered 50 Covered Wagon trailers for the national parks, of which the first 20 units have been delivered.

UAW Acts When Ford Closes

Union Will Push Membership Drive During 3-Week Plant Shutdown

The United Automobile Workers will take advantage of the three-week Ford plant shutdown at Detroit to carry its membership drive directly to the workers at their homes. By no means all the Rouge plant's 89,000 employes will be off duty for the inventory-taking period and therefore available to organizers. The company has announced that a number of departments will remain at work and that some workers will be called back on part time during the closure.

Offices of the Ford Motor Co. had no comment to make on the union's decision to go forward at this time, other than to say that the union would naturally be unable to secure any addresses from Ford records. The union offices would give no indication of the procedure it would follow in seeking to contact the workers.

Meanwhile the National Labor Relations Board continued its hearings at the Federal Building in Detroit on the case against the Ford company for discrimination and other unfair labor practices. Witnesses testifying before John T. Lindsay, trial examiner, said that they had made efforts to find out why they were discharged last May and June after what they felt were satisfactory working records for a number of years. Some of them stated that they had been warned by foremen that they would be fired if they discussed the union. Several of the witnesses said they would take their jobs again if they could get them. They had refused other and heavier jobs at the plant, but denied they had been loafing, it was brought out.

It was reported at the hearings that the Ford Brotherhood of America, Inc., is again active at the Rouge plant. The union has been denounced by labor as a company union.

At the hearing on July 20, a former Ford foreman testified that he had been ordered by a superintendent to fire "some of those men." He said he was told to "get a reason and fire them" and that he "had an idea" they were being fired for being union members.

The Ford defense, headed by Louis J. Colombo, will probably put on a number of foremen as witnesses who will testify that the men were discharged for inefficiency. The phase of the hearings during which the NLRB has introduced witnesses will end some time prior to July 24, it was indicated.

Eight men and the Ford Motor Co. will be tried in the fall on charges growing out of the May 26 riot at the Ford Rouge plant gates in which several union organizers were injured. Common Pleas Judge Ralph W. Liddy said he found probable cause to hold the defendants for trial. The charges are assault with intent to do great bodily harm less than murder. The several defendants are described as service and production department employes and in two cases as a boxer and as a wrestling referee.

Automotive Metal Markets

Steel Market Reflects Encouraging Interest of Automotive Consumers; Present Prices on Most Rolled Products to Continue

In contrast with the midsummer dullness of pre-depression years the steel market reflects at this time encouraging interest on the part of automotive consumers. Ford Motor Co. is reported to have put out inquiries for 100,000 tons, with the placing of definite orders for this material looked for before the end of the month. General Motors had previously contracted for round tonnages of body stock. Chrysler Corp. also has inquiries out for its flat steel requirements for initial 1938 model assemblies. It is also thought that General Motors Corp.'s annual contracting for its pig iron requirements is not far off, giving the necessary fillip to buying by other automotive foundries.

Most of the flat steel business that overhangs the market is for September shipment, rolling and finishing mills thus being enabled to plan orderly production schedules. Meanwhile backlogs suffice to keep the rate of mill operations on a fairly even keel, although in some descriptions of steel a wide gap between shipments and the volume of fresh orders is noted. Announcement was made this week by the leading interests that present prices on bars, sheets, strip and most other rolled products will be continued for fourth quarter delivery. With independents following suit, the price problem is thus eliminated over the remainder of the year.

Dissatisfaction with sustained high tin prices continues. Shipments from the Straits Settlements are reported to be running 2000 tons ahead of estimates cabled from Singapore early this month. One of the largest single shipments on record, 1750 tons, is expected to arrive from the Orient late next month. Another bit of comforting news coming from LaPaz, Bolivia, is that the new government of that South American Republic will give every possible aid to the tin producers in their efforts to increase tin shipments. An authority predicted recently that Bolivian shipments over the remainder of the year would increase from 1800 to 2500 tons a month, the Bolivian quota being close to 4000 tons.

On the other hand, supplies from China, which normally make up about 6 per cent of American consumption, may suffer as the result of that country's troubles with Japan. Of temporarily greater importance than any of these basic influences is the attitude of some London market factors who appear to look upon 60-cent tin as justified under present conditions. Other London interest, however, consider this price top-heavy and, as has so often been the case, the American consumer pays while bulls and bears fight it out in London.

Pig Iron—Talk of $1 per ton advance for the fourth quarter is being kept alive, but is not taken as seriously as a few weeks ago.

Aluminum—Prices of some grades of secondary aluminum have been reduced fractionally. Better inquiry, however, gives the market a firmer undertone.

Copper—Steady and unchanged.

Tin—Spot Straits tin was quoted at 59⅞ cents at the beginning of the week, but on Tuesday the price range rose to 60⅜ @ 60½ cents under the influence of stock market improvement.

Lead—Storage battery manufacturers bought freely. The market is steady and unchanged.

Zinc—Ore prices advanced 50 cents a ton. Slab zinc quotations are unchanged, with the market firm.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

Sir David Salomons on Motor Traffic

Sir David Salomons concluded a rather lengthy exposition on motor vehicles with the following comments: "For motor cycles, benzine motors probably have the advantage. In all other cases, steam promises to be the motive power when real work is called for, and where a return upon capital expenditure is required.

"Electric energy, if necessary adjuncts exist, has a great field open in towns, as a luxury, where the question of upkeep is not a vital item.

"Finally, the best existing motor the world has yet seen, for its power, method of fueling, suspension springs, and traveling long distances before recharging, is one which is likely to remain with us for many a long year to come, whatever may be the future development of motor traffic. It is known and loved by all, young and old, under the name of the horse."

—From *The Horseless Age*, July, 1897.

Plant Notes

Fram Moves Offices to Providence; New Conveyors for Cadillac-LaSalle

The transfer of executive and sales offices as well as eastern manufacturing operations from Worcester, Mass., to a newly purchased factory at East Providence, R. I., has been announced by Steven B. Wilson, president of the Fleming Manufacturing Co., manufacturers of the Fram oil and motor cleaner. Steady expansion in sales of Fram cleaners necessitated larger plant facilities to meet production demands.

Fram oil cleaners are also being manufactured in the Bellevue, Ohio, plant. Combined capacity of both plants is said to be over 100,000 filters and 150,000 cartridges monthly.

A new conveyor system that will facilitate handling of bodies in the production of Cadillacs and LaSalles has been announced by General Manager Nicholas Dredystadt.

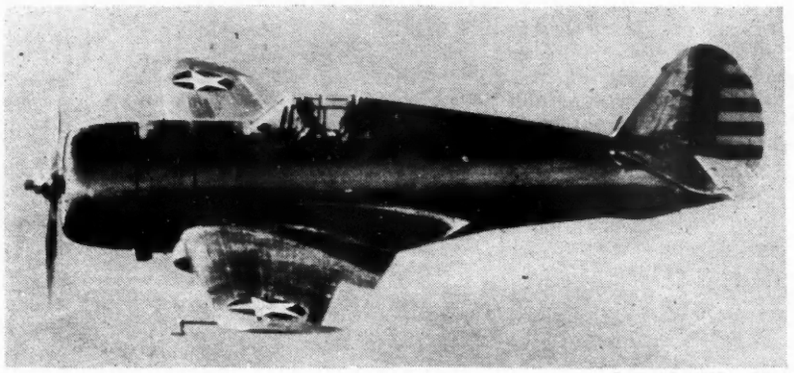
The improvement program also includes an enclosed unloading platform where the receipt of bodies can be increased from the present maximum of 18 per hour to 50.

Six parallel conveyor lines, each 264 ft. in length, have been installed. Stops on these conveyors are automatic, the lines moving only enough to replace the body withdrawn for final assembly operations. A special 374-ft. conveyor, starting at the body drop, will be used to return body trucks to the platform.

A double-deck feature on the unloading platform will permit simultaneous removal of bodies from the upper and lower quarters of the truck trailers that travel between the Cadillac and Fisher and Fleetwood plants.

Wisconsin Gray Iron Foundry Co., Milwaukee, has purchased the gray iron foundry unit of the old National Brake & Electric Co., foot of East Belleview Place, Milwaukee, from the Westinghouse interests and will spend about $30,000 in modernization and reconditioning work. The foundry has been idle about six years. Present capacity will be more than doubled.

Goodyear Tire & Rubber Co. has leased the Jonas building, 125 by 200 ft., 2 stories and basement, at 1707 East North Avenue, Milwaukee, for its Milwaukee factory branch and warehouse. This will more than double its present branch house space at 118 South Second Street. The lease is for five years.



International News Photo

CONTRACT for 230 Curtiss pursuit all-metal monoplanes, of the type pictured here, has been placed by the War Department with the Curtiss-Wright Corp., Curtiss Aeroplane Div. of Buffalo, N. Y. It is a Curtiss P-36 low wing ship, powered by an 1100 hp. radial air-cooled engine. The plane will be capable of more than 300 m.p.h. It is equipped with a retractable landing gear and tail wheel.

FTC Hits Motor Advertising

Ford Motor Co. and General Motors are charged with making "false and misleading representations" in advertising the prices of automobiles in a complaint issued July 20 by the Federal Trade Commission. In stipulations signed a few weeks ago, seven other manufacturers of automobiles agreed to refrain from certain advertising practices found objectionable by the commission.

The present complaint which is similar in tenor to those previously levelled against other manufacturers charges:

"That advertisements are arranged in such a manner as to create the impression that fully equipped cars so illustrated and described may be purchased at the f.o.b. or delivery point complete and ready for operation for the prices featured, or at other points for the featured prices plus the cost of transportation."

The cars so advertised, the commission alleged, are not those usually sold for the featured price. The featured price, it said, usually is the cost of the companies' less expensive cars.

The companies were given twenty days to answer the charges.

E. G. Budd Profits Increase Over '36

The Edward G. Budd Mfg. Co. has reported a net profit of $664,409.55 for the second quarter of the year after deducting all charges including interest, depreciation and taxes but not including any provision for Federal undistributed profits tax. This compares with net earnings of $339,585.42 in the second quarter of 1936.

Earnings for the first six months of this year were $1,090,864.24, which compares with an operating profit of $685,835.83 for the first six months of 1936 after providing for current preferred dividends. Earnings per share for the first six months of 1937 were equal to 53 cents per share on the 1,656,808 shares of common stock outstanding. In the first half of 1936, earnings were equal to 33 cents per share on the 1,422,630 shares of common stock then outstanding.

June Production 11% Over 1936

Passenger Car and Truck Production

(U. S. and Canada)

	June, 1937	May, 1937	June, 1936	Six Months, 1937	Six Months, 1936
Passenger Cars—U. S. and Canada:					
Domestic Market—U. S.	387,121	400,415	357,651	2,136,582	1,927,177
Foreign Market—U. S.	24,273	25,017	17,686	150,376	114,285
Canada	17,919	17,980	12,846	96,823	84,965
Total	429,313	443,412	388,183	2,383,781	2,126,427
Trucks—U. S. and Canada:					
Domestic Market—U. S.	66,317	74,390	64,461	404,373	373,478
Foreign Market—U. S.	19,587	17,077	13,170	97,518	73,620
Canada	5,922	5,478	3,554	31,748	20,983
Total	91,826	96,945	81,185	533,639	468,081
Total—Domestic Market—U. S.	453,438	474,805	422,112	2,540,955	2,300,655
Total—Foreign Market—U. S.	43,860	42,094	30,856	247,894	187,905
Total—Canada	23,841	23,458	16,400	128,571	105,948
Total—Cars and Trucks—U. S. and Canada	521,139	540,357	469,368	2,917,420	2,594,508

Mr. Knudsen's Letter

(Continued from page 103)

clusion. In many cases, the strikes were called before the management was aware of any claim that a grievance had arisen.

Your second point that the shop committees provided in the agreement were of insufficient number to cover the plant, was met by us agreeing to a committee member for each four hundred men. That this is sufficient, is borne out by the fact that in certain of our plants, where the committees have functioned with reason and dispatch, your organization has not found it necessary to appoint the additional members granted.

It is obvious that it is not the grievance procedure which is responsible for the failure of the Union to keep its agreement.

Our position stated in my letter of June 23, 1937, is unchanged. We there suggested as a necessary stipulation covering the responsibility for interruptions to production, the following:

"It is the responsibility of the management to maintain discipline in its shops, and the right of the employer to hire, fire and discipline employes for cause is expressly recognized. Until after all the steps set forth in the grievance procedure set up in this agreement have been complied with, no strike shall be called, and there shall be no refusal to work or stoppage of production in whole or in part due to the Union, its officials or members, and for a violation of this provision, the com-

pany shall forthwith discharge the employe or employes guilty thereof, and the Union shall take suitable disciplinary action against the parties responsible.

"For failure on the part of the Union to take such action, or to prevent strikes and stoppages to production, as herein provided for, the company shall have the right to terminate the agreement."

We therefore reiterate what we stated in our letter of June 29, viz:

"We must repeat our insistence that this basic issue will have to be negotiated and settled satisfactorily by a clarifying clause, such as we have suggested to be incorporated in the agreement, before there is any justification for negotiations of additional issues."

Your very truly,
W. S. KNUDSEN,
President.

Production Sustained

(Continued from page 103)

Hudson is holding at a 2000 car a week rate for the time being.

Studebaker Corp. reported sales from Jan. 1 to July 10 of 58,187 passenger cars and trucks, against 48,207 for the like period last year, a gain of 21 per cent. Sales for ten days in July alone were 1548 units against 623 last year.

Graham Paige Motors Corp. is running at the rate of about 1400 cars for July, based on results up to July 19. This would compare with 1487 cars shipped in June and with 1247 shipped in May. For eight months ended June 30, a cross section of 35 distributors representing about 25 per cent of the distributor body took 4319 Graham 1937 models.

ROBERT J. PURCELL has been appointed New York State district manager for the White Motor Co. One of Mr. Purcell's first official moves was the appointment of David L. Hennigar as White branch manager at Buffalo.

RUDOLPH FURRER has been elected vice-president in charge of engineering of A. O. Smith Corp.

MAURICE PLATT has resigned his position as technical editor of "The Motor" and has joined the engineering staff of Vauxhall Motors, Ltd.

J. E. MAYL, assistant sales manager of the Goodyear Tire & Rubber Co. of Akron, has been appointed vice-president of the Los Angeles Co. in California. Other recent personnel changes announced by Goodyear include: **H. E. BLYTHE,** assistant sales manager in charge of retail sales, has been made sales manager of the tire department in charge of wholesale and retail tire sales in Akron; **H. G. HARPER,** advertising manager of the parent company succeeds **W. A. HAZLETT** as western division manager, the latter being appointed managing director of the British Co. of Wolverhampton, England;

J. K. HOUGH, former managing director of the British Co., will fulfill duties as advertising manager in Akron.

K. W. VANCE has been appointed merchandising manager of the DeSoto Div. of the Chrysler Corp.

D. M. HERRICK, formerly assistant to DeSoto's president Byron C. Foy, has been named director of regions of the DeSoto Div. of the Chrysler Corp.

Indianapolis Drops Fuel Limit

Speedway to Adopt New International Racing Formula; Foreign Competition Invited for '38 Contest

International competition will be invited in the race at the Indianapolis Motor Speedway next May 30 by the removal of all restrictions which in the past several years have appeared to mitigate against foreign cars.

Capt. E. V. Rickenbacker, president of the Speedway, announced that the new international racing formula will be adopted in its entirety and that all restrictions on fuel would be dropped. Also for the first time in years it will not be necessary to carry riding mechanics.

The new rules permit superchargers on motors within the limits of 183 cu. in. piston displacement and the maximum limit on all engines will be 274 cu. in. without superchargers.

In the interest of motor car development, the first fuel restriction was placed on cars at Indianapolis in 1934 when the racers were allowed but 45 gal. of fuel to complete the 500-mile contest. In 1935 the amount of fuel was further reduced to 42½ gal., and another reduction to 37½ was ordered in 1936.

Last year the limit on the amount of gasoline used was lifted but cars were restricted to the use of stock fuel rather than the special mixtures formerly used. Foreign cars are so constructed that it is almost impossible for them to obtain their maximum efficiency with stock gasoline and cars from across the sea passed up the speedway classic because of this restriction.

Indianapolis returned to two-man cars in 1930 after several years of racing with one man jobs and a riding mechanic has been mandatory ever since. Foreign cars are single seaters, but may not be less than 33.46 in. wide, and the breaking down of this other rule will encourage them to try for the $100,000 in prize money.

Budd Wheel Reports 2nd Quarter Profits

The Budd Wheel Co. has reported a profit of $259,253.45 for the second quarter of the current year after deducting all charges including depreciation, interest and taxes, but not including any provision for the Federal undistributed profits tax. This compares with $299,769.91 for the corresponding period of the previous year.

Earnings for the first six months of 1937 were $520,959.97 equal to 52 cents per share on the 965,258 shares of common stock outstanding, after providing for preferred dividends. This compares with earnings of $518,692.78 for the first six months of 1936 equal to 51 cents per share on the same number of outstanding shares.

Automotive advertising lineage in newspapers dropped 6.6 per cent in June compared with May figures, according to *Editor and Publisher.* The data:

	1937 Lineage	1936 Lineage	Percentage of 1936
June ..	7,332,243	7,644,775	95.9
May ...	7,462,140	8,493,445	87.9

Passenger Car Production by Wholesale Price Classes

(U. S. and Canada)

Six Months 1937 and 1936 Compared

	1937	1936	Per Cent Change	Per Cent of Total 1937	Per Cent of Total 1936
Under $500	1,150,241	1,147,185	+ 0.4	48.26	53.96
$501 to $750	1,126,208	873,159	+29.0	47.24	41.06
$751 to $1000	78,189	74,304	+ 5.1	3.28	3.49
$1001 to $1500	20,000	23,453	−14.7	.84	1.10
$1501 to $2000	7,080	5,523	+28.0	.30	.26
$2001 to $3000	1,941	2,584	−24.8	.08	.12
$3001 and over	122	219	−44.3	....	.01
Total	2,383,781	2,126,427	+12.1	100.00	100.00

Truck Production by Capacities

(U. S. and Canada)

Six Months 1937 and 1936 Compared

	1937	1936	Per Cent Change	Per Cent of Total 1937	Per Cent of Total 1936
1½ Tons and less	501,068	439,294	+14.1	93.90	93.85
2 to 3 Tons	20,432	19,564	+ 4.3	3.83	4.18
3½ Tons and over	6,309	4,100	+53.8	1.18	.88
Special and buses	5,830	5,123	+13.9	1.09	1.09
Total	533,639	468,081	+14.0	100.00	100.00

Chevrolet Adds Two Trucks

Augments Line with ¾ and One-Ton Models; Weights 5200 and 5800 Lb.

Between its half-ton and 1½-ton trucks Chevrolet has inserted a ¾-ton and one-ton model, having gross vehicle weights of 5200 and 5800 lb. Each has a standard wheelbase of 122¼ in. Front and rear tread of the one-ton model are narrower to assist maneuverability of the larger unit.

Engine in the new models is the Chevrolet standard 78 b.hp. truck design. The clutch on both models is said to be identical with that used in 1½-ton models, and the transmission from the half-ton model, standard on the new jobs, can be optioned by the four-speed transmission used in the 1½-ton model. Single-acting shock absorbers are included in the rear suspension of the ¾-ton. model. Only single rear wheel equipment is available on both new models. Prices are: ¾-ton chassis, $430; one-ton chassis, $465.

Truck Strikes Hit Tire Factories

Shipment of raw materials into Akron tire and rubber goods factories and shipment of finished tires out of Akron to car manufacturers and to the retail dealer market have been seriously affected during the past week by strike called by Akron Truck Drivers' Union which tied up more than 200 trucks of 35 lines operating out of Akron.

While a few trucking companies have signed contracts with the union giving increases of from 55c. to 70c. an hour for city trucking and from 65c. to 75c. for road jobs to 400 drivers, there are still over 24 concerns that have not signed with the union. It is probable that those who have signed will not be allowed to operate until all have signed.

The bulk of Akron products, tires and tubes and mechanical goods are shipped out of Akron by truck.

AUTOMOTIVE INDUSTRIES

Looks Ahead

BEARINGS (ball and roller) in motor vehicles are often more damaged in shipment than in service. This curious paradox, which because of its resemblance to the effects produced by the famous hardness test has been called erroneously "brinelling," has been analyzed exhaustively by J. O. Almen, of General Motors Research. A definitive edition of his interesting paper on the subject will appear in an early issue.

TRACTOR production will be highlighted in the story of manufacturing at the Minneapolis-Moline plant, to appear in our issue of Aug. 7, as part of the regular first-of-the-month series of production articles by Joseph Geschelin.

Ford Modernizes N. Y. Showrooms

Contracts have been awarded by the Ford Motor Co. for modernization of its showrooms at 1710 Broadway, New York. The Broadway structure, which has been Ford headquarters in New York for 20 years, will be remodeled to provide facilities for a permanent year-round exhibit of Ford products.

The annual Ford-Lincoln automobile show, held concurrently with the National Automobile Show at Grand Central Palace, will be staged in the remodeled five-story building. Contracts call for completion of the remodeling program by Oct. 15.

Construction plans include major changes in the first floor of the building, as well as new automobile salons on the mezzanine, second and third floors. Air conditioning will be installed.

June Crude Rubber Consumption—51,798 Tons

Consumption of crude rubber by manufacturers in the United States during the month of June is estimated to be 51,798 long tons, which compares with 51,733 long tons during May. June consumption shows an increase of less than 1 per cent over May but is 1.8 per cent under June a year ago, according to statistics released by the Rubber Manufacturers Association.

Gross imports of crude rubber for June are reported to be 48,956 long tons, a decrease of 3.7 per cent under the May figure of 50,840 long tons but 17 per cent over the 41,835 long tons imported in June, 1936.

The Association estimates total domestic stocks of crude rubber on hand June 30 at 169,646 long tons, which compares with May 31 stocks of 172,985 long tons and 245,544 (revised) long tons on hand June 30, 1936.

June reclaimed rubber consumption is estimated at 14,414 long tons, production 16,052 long tons, stocks on hand June 30, 14,535 long tons.

Calendar of Coming Events

SHOWS

Second Winter Item Show, Automobile Accessories Association, Chicago, Aug. 9
Poland, Automobile Salon (Foire Orientale), Lwow .....Sept. 1-15
Yugoslavia, Automobile Section, Autumn Fair, Ljubljana .....Sept. 1-12
Yugoslavia, Automobile Section, Commercial Fair, Belgrade.....Sept. 11-21
France, 31st International Automobile Salon, Paris .....Oct. 7-17
Great Britain, 31st International Automobile Exposition, London....Oct. 14-23
Czechoslovakian Automobile Show, Prague .....Oct. 16-24
National Automobile Show, New York, Oct. 27-Nov. 3
Toledo, O., Automobile Show..Oct. 27-Nov. 3
Italy, 10th International Automobile Salon, Milan .....Oct. 28-Nov. 8
Boston, Mass., Automobile Show, Oct. 30-Nov. 6
Los Angeles, Cal., Automobile Show, Oct. 30-Nov. 7
San Francisco, Automobile Show, Oct. 30-Nov. 7
Cincinnati Automobile Show.Oct. 31-Nov. 6
Great Britain, 13th International Commercial Automobile Exposition (trucks and buses), London...Nov. 4-13
Chicago Automobile Show.....Nov. 6-13
Akron Automobile Show.....Nov. 6-12
Omaha Automobile Show.....Nov. 6-11
Brooklyn Automobile Show.....Nov. 6-13
Columbus Automobile Show .....Nov. 6-12
Detroit Automobile Show.....Nov. 6-13
Motor Truck Show, 4th Annual, Newark, N. J. .....Nov. 6-12
Newark, N. J., Truck Show.....Nov. 6-12
Buffalo, N. Y., Automobile Show..Nov. 6-13
Indianapolis, Automobile Show....Nov. 6-13

Show Business

Manager of the National Automobile Show in New York is Alfred Reeves, 366 Madison Ave., N. Y. C. Inquiries concerning all matters connected with the national show should be addressed to him. AUTOMOTIVE INDUSTRIES will be pleased to furnish names and addresses of local show managers on request.

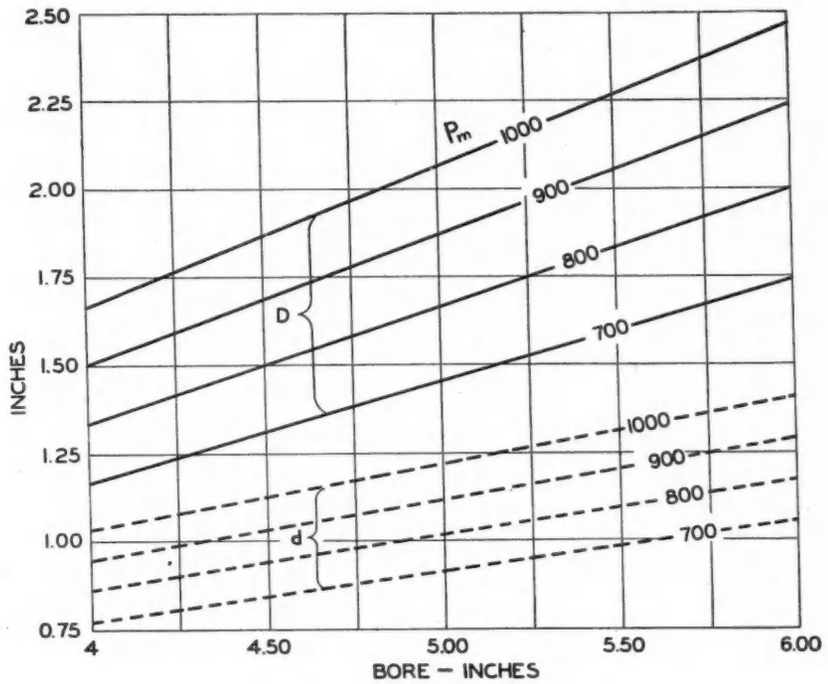
Newark, N. J., Automobile Show..Nov. 6-13
Philadelphia Automobile Show....Nov. 6-13
Pittsburgh, Pa., Automobile Show.Nov. 6-13
Toronto, Ont., Automobile Show..Nov. 6-13
Great Britain, 36th Scottish International Automobile Exposition, Glasgow .....Nov. 12-20
Baltimore, Md., Automobile Show, Nov. 13-20
Cleveland, Ohio, Automobile Show, Nov. 13-20
Jersey City, N. J., Automobile Show, Nov. 15-20
Milwaukee, Wis., Automobile Show, Nov. 17-24
Springfield, Mass., Automobile Show, Nov. 14-20
St. Louis, Mo., Automobile Show.Nov. 14-21
Portland, Ore., Automobile Show.Nov. 14-21
Denver, Colo., Automobile Show, Nov. 15-20
Montreal, Que., Automobile Show, Nov. 20-27
Kansas City, Mo., Automobile Show, Nov. 27-Dec. 4
A.S.I. Show, Navy Pier, Chicago, Dec. 6—Dec. 11

CONTESTS

National and International Soap Box Derby Finals, Akron, Ohio.....Aug. 15
Pan American Cup Race, Roosevelt Raceway .....Sept. 6
National Outboard Championship Regattas, Richmond, Va.....Sept. 18-19

CONVENTIONS AND MEETINGS

U.A.W. Annual Convention, Milwaukee, Aug. 23
International Congress on Carbohydrate Carburants, Rome .....Sept. 10-12
S.A.E. Section Regional Tractor Meeting, Akron, Ohio.....Sept. 15-17
American Transit Association, 56th Annual Convention, White Sulphur Springs, W. Va.....Sept. 19-23
S.A.E. Section Regional Transportation Meeting, Chicago .....Sept. 29-Oct. 1
American Foundrymen's Association Midyear Meeting, Columbus, Ohio, Sept. 30-Oct. 1
S.A.E. Fuels and Lubricants Regional Meeting, Tulsa, Okla. ...Sept. 30-Oct. 1
S.A.E. National Aircraft Production Meeting, Los Angeles, Calif.....Oct. 7-9
American Foundrymen's Association, Regional Conference, Rolla, Mo., Oct. 8-9
National Metal Congress, Atlantic City, Oct. 18-22
S.A.E. Annual Dinner, Commodore Hotel, New York.....Oct. 28
American Petroleum Institute, 18th Annual Meeting, Stevens Hotel, Chicago .....Nov. 8-12
S.A.E. National Production Meeting, Flint, Mich. .....Dec. 8-10



Graph for piston-pin outside and inside diameters, for high-speed Diesel engines

Piston-Pin Design

A New Method of Calculating Dimensions of Piston Pins For High-Speed Diesel Engines Which Takes Account of Cylinder Bore and Maximum Combustion Pressure

By P. M. Heldt

OWING to the much higher gas pressures reached in Diesel engines, the dimensions of certain parts of these engines differ materially from those of corresponding parts of gasoline engines. For such parts as the main bearings, an allowance of 10 per cent is sometimes made to take care of the extra loads as compared with a gasoline engine of the same cylinder dimensions, but in the case of the piston-pin bearings, which take the gas-pressure loads most directly, this does not seem to be sufficient, judging from the proportions for piston pins commonly used in the two types of engine.

Defects and weaknesses of certain parts often make themselves felt in failures of adjacent or dependent parts. For instance, a European manufacturer of light alloy pistons noticed that cracks in pistons of high-speed Diesel engines often originated at the piston bosses. The first impulse was to ascribe the failures to defects in the design of the pistons or in the materials from which they were made, but closer investigation showed that they were the direct result of lack of sufficient rigidity of the piston pins. In an effort to make the reciprocating parts as light as possible, these pins are always made tubular, and sometimes the walls of the tube are made entirely too light. By applying hydraulic pressure to a piston pin of this type, assembled in its piston, Professor Ensslin showed* that the pin deforms from its original cylindrical shape and takes on an elliptic cross section. The investigation led to the development of a new method of calculating the dimensions of piston pins for high-speed Diesel engines, taking account of both the cylinder bore B and the maximum combustion pressure p_m.

*The method was described in an article in the Research Reports of the GHH Concern, of which an abstract appeared in the *Zeitschrift des Vereines Deutscher Ingenieure*, March 27. The method is here adapted to English units of measurement.

The change in diameter of the hollow pin under the influence of a total gas pressure P is

$$w = \frac{5\ P\ D^3}{12\ l\ E\ h^3}\ \text{in.},$$

where D is the outside diameter of the pin; l, the length of the pin; E, the modulus of rigidity of the material; and h, the double wall thickness or the difference between the inner and outer diameters. In order that the oil film on the pin may not be broken down, w must not be allowed to exceed 0.001 in.

The necessary outside diameter of the pin is calculated from the assumed maximum combustion pressure p_m, and on the basis of a bearing length equal to one-third the bore and a maximum permissible specific bearing load of 5680 lb. per sq. in. This leads to the following proportions between bore and pin diameter for various values of p_m:

$B/D = 2.412$ for $p_m = 1000$ lb. per sq. in.
$B/D = 2.68$ for $p_m = 900$ lb. per sq. in.
$B/D = 3.01$ for $p_m = 800$ lb. per sq. in.
$B/D = 3.45$ for $p_m = 700$ lb. per sq. in.

The double wall thickness of the pin evidently is

$$h = \sqrt[3]{\frac{5\ P\ D^3}{E\ l\ w}}\ \text{in.},$$

and making $w = 0.001$ in., and $E = 30{,}000{,}000$ lb. per sq. in., this becomes

$$h = 0.024\ \sqrt[3]{\frac{P\ D^3}{l}}\ \text{in.}$$

In the accompanying chart are shown the outside diameters D and the inside diameters d required for crankpins for engines of 4-6 in. bore and with maximum explosion pressures of 1000, 900, 800 and 700 lb. per sq. in., respectively. The inertia forces are neglected in the calculations (which seems justifiable because the piston pin must withstand the stresses imposed upon it at low speeds, when the inertia forces are small). In calculating the necessary internal diameters the length of the pin was assumed as equal to 0.8 B.

It is stated in the article referred to* that this method of determining piston-pin dimensions has worked out well in practice within the cylinder-bore range of 100 to 150 mm., which is substantially equal to 4-6 in.

Of the 7000 or more automotive manufacturing organizations, few can afford to maintain their own engineering schools. The quality of automotive education is, therefore, the concern of most automotive executives. With the article which appears below AUTOMOTIVE INDUSTRIES begins an informal qualitative survey of automotive engineering education (and its corollary research activities) with the story of a contribution by Alfred P. Sloan, Jr., the . . .

M. I. T. Laboratory

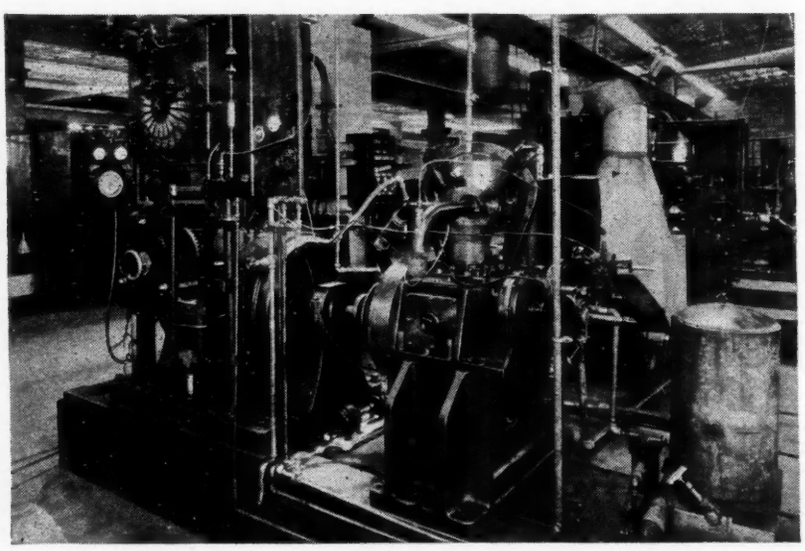
By H. E. Blank, Jr.

WITH fundamental research rapidly attaining more and more importance in the automotive industry, due in part to the fact that refinement of design rather than invention is now widely recognized as most essential to continued progress, the research program carried out in the Sloan Automotive Laboratory at the Massachusetts Institute of Technology seems of especial interest.

The policy governing selection of problems for investigation at the Institute is expressed by C. Fayette Taylor, professor in charge of instruction and research in internal combustion engines for both the aeronautical and automotive engineering courses at M.I.T., as follows: "We try to select problems definitely connected with automotive work, and yet of such nature that they would not naturally be taken up by the manufacturer's laboratories. Within this field come fundamental studies of gaseous combustion, of the nature of detonation, of cooling and heat transfer, of engine vibration and its measurement and control, of the statics and dynamics of air supply to engine cylinders (both for two-stroke and four-stroke engines), and of the performance characteristics of fuels not yet commercially available."

It is Professor Taylor's belief that the research problems best suited to a university engineering laboratory are intermediate between the problems generally handled by private laboratories and those within the scope of the research chemist or physicist. Naturally the university laboratory cannot compete with commercial laboratories in development work but, in the words of this professor, "there would be no justification for a well equipped engineering laboratory if it confined itself to pure physics and chemistry." An infinite number of problems exist between these extremes, and it is within this range that research investigations at M.I.T. cover a very useful field. The long list of published reports on experimental work in the Sloan laboratory is impressive evidence in itself that M.I.T. is performing noteworthy service that extends beyond its prime function of educating young engineers.

All facilities for internal combustion engine research are located in a one-floor building, approximately 80 by 160 ft., given to the Institute by Alfred P. Sloan, Jr., new chairman of General Motors. Available at each test stand are service connections with underground pipe lines supplying—in addition to water, steam, air, and three kinds of fuel—air under pressure for supercharging and low-pressure exhaust for simulating altitude conditions. An exhaust disposal system keeps the trenches, in which supply pipe lines are placed, free of dangerous fumes. Other equipment not indicated on the accompanying schematic floor plans, page 127, includes T-slots in the floor arranged for clamping test unit bed plates in different positions, two over-head cranes,



Single-cylinder test engine with adjustable connecting rod and valve gear to take different sizes and types of cylinders.

Edward Story Taylor

THIS year, 54 Fellows of the Institute of Aeronautical Sciences conferred the Sylvanus Albert Reed Award on E. S. Taylor, associate professor of Aeronautical Engineering at the Massachusetts Institute of Technology, for his invention of a dynamic absorber to decrease camshaft torsional vibration of aircraft engines. The mechanism was developed by Mr. Taylor when he was called in by the Wright Aeronautical Corp. in 1934 to consult on problems in crankshaft torsional vibration.

His first industrial connection in a professional capacity was as engineering assistant in the Public Service Production Co., subsidiary of Public Service Corp., Newark, N. J. In 1926 he was named assistant in the engineering department of the Wright Aeronautical Corp. He was appointed instructor in aeronautical engineering at M.I.T. in 1927, being elevated to assistant professor in 1929 and to his present position in 1937.

He has authored numerous technical articles published in various periodicals.

Charles Fayette Taylor

APPOINTED professor of Automotive Engineering in October, 1929, C. F. Taylor has continued since that time in charge of instruction and research in internal combustion engines for both the aeronautical and mechanical engineering courses at the Massachusetts Institute of Technology.

Among numerous engineering positions he held prior to appointment in 1926 as associate professor of aeronautical engineering at M.I.T. are: engineer, American International Corp.; civilian inspector of aircraft material, U. S. Signal Corps; officer in charge of aeronautical engine laboratory, U. S. Navy, Washington, D. C.; engineer in charge of power plant laboratory, Engineering Division, U. S. Air Service, McCook Field; assistant chief engineer in charge of engine design and development, Wright Aeronautical Corp.

By request of the Imperial Japanese Navy, he journeyed to Tokyo in 1931 to present a series of lectures on aircraft engine design before Japanese engineers.

He has been engaged as consulting engineer by many industrial concerns, including: Aviation Corp. (American Airways), Continental Aircraft Engine Corp., Wright Aeronautical Corp., Lawrance Aircraft Engine Corp., and Steel Products Engineering Corp.

and resistance banks to absorb energy output from the dynamometers.

The testing equipment, a large portion of which was donated by H. M. Crane, technical assistant to the president of General Motors, includes a number of engines of different types coupled to electric dynamometers or water brakes. Some of these test stands are arranged in the usual manner for economy and power tests and are used principally for laboratory instruction of undergraduate students. The greater part of the equipment consists, however, of apparatus especially designed for research.

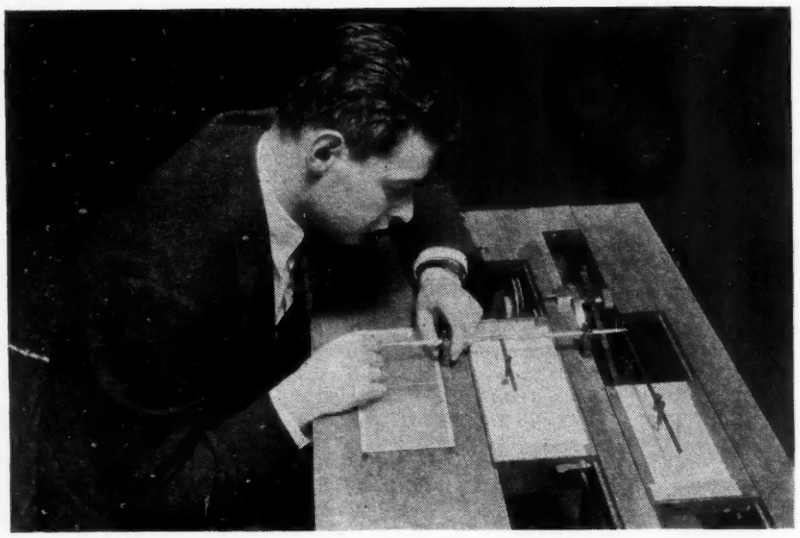
Since the research program stresses investigation into the fundamentals of the engine cycle, there are a number of single cylinder engines. Three of the dynamometer test stands are equipped with "universal" crankcases providing a high degree of flexibility in the type and size of cylinder which can be installed. Various types of valve gear and auxiliaries are readily attached, and compression ratio may be varied by adjusting the connecting rod which has a threaded joint for the purpose. In general, adjustment of variable elements cannot be made on these crankcases while the engine is operating.

The laboratory is also equipped with a N.A.C.A. universal test engine with fixed cylinder design. It is possible on this set-up to make a wide range of adjustment of variables while the engine is operating.

Electric cradle dynamometers range in capacity from 10 to 300 hp., each being completely equipped with measuring apparatus. Coupled to two of the smaller dynamometers are Cooperative Fuel Research engines utilized for general research purposes as well as for knock rating investigations. A small L-head engine, also coupled to a dynamometer, is arranged for observations and measurement of the combustion flame. Glass windows are installed in the flat top of the engine combustion chamber.

A number of instruments have been developed at the M.I.T. laboratory. Among these is a balanced-diaphragm indicator which has proved very satisfactory for purposes requiring the averaging type. For obtaining a record of a single cycle, an indicator using electro-dynamic pick-up from a diaphragm exposed to the cylinder pressure is being developed. It operates a cathode-ray oscillograph through an amplifying circuit.

While faculty members are usually present in the laboratory, much of the actual operation of equipment and recording of data is done by students. In addition to the brothers, C. F. Taylor and E. S. Taylor, the staff is composed of research associate A. R. Rogowski, research assistants M. C. McLeod, C. L. Bouchard and Blake Reynolds. (*Next page.*)



Machine developed at M.I.T. for converting pressure-time indicator diagrams to pressure volume basis.

Perhaps one of the best ways to explain the nature of the experimental work being done in the Sloan automotive laboratory is to describe some of the investigations recently made. Measurement of friction horsepower based on motoring tests are not especially accurate because results are not obtained under conditions existing while the engine is operating. For instance, a large portion of the loss is due to piston friction and deviations in cylinder wall temperatures or condition of the lubricating oil introduce appreciable errors. In order to get some idea of the magnitude of these errors, M. C. McLeod has recently studied the indicator method of measuring friction horsepower. Friction loss was measured by determining the difference between indicated horsepower and brake horsepower; b. hp. being measured by dynamometer and i. hp. calculated from the planimetered area of indicator cards. Pressure-time diagrams taken on an M.I.T. indicator were converted to the pressure-volume basis on a special machine developed at the laboratory for this purpose. A photograph of the instrument is shown on this page.

A. J. Junker and Martin Garrot have been studying the air capacity and performance of a motor car engine in the region of the power peak. In the experimental set-up, a 1935 Ford V-8 engine was connected to a dynamometer through a 2.01 reduction gear. This investigation showed that there is a peak in the indicated horsepower vs. r.p.m. curve and that this peak is due to a similar peak in the curve of air capacity. For determining indicated horsepower, both the indicator and motoring methods were used.

Another research project concerned with friction was that of A. E. Hale and E. H. Olmstead, two students who just made a study of the effect of variation in inlet and exhaust pressures upon both pumping and mechanical friction of a spark ignition internal combustion engine. For their experimental work on this project they used a Waukesha C.F.R. engine direct connected to a cradle dynamometer. The engine was standard type except for Bosch fuel injection into an oversize inlet manifold, instead of conventional carburetion. It might be mentioned here that in order to avoid variations in fuel quantity and at the same time to keep it accurately under control, the ordinary form of carburetor has, for most laboratory purposes at M.I.T., been discarded in favor of a Diesel-type fuel-metering pump which injects a finely atomized jet of fuel into the intake pipe or cylinder.

Of much interest is a research being conducted for the National Advisory Committee for Aeronautics on the effect of port shape and timing on the scavenging efficiency of a two-cycle cylinder. The cylinder used in this project is of the single-piston ported type and was designed by A. R. Rogowski of the M.I.T. automotive staff and E. W. Morris. Basic design elements include provision for variable port timing, variable port shape, and variable compression ratio. With the special arrangement, exhaust port timing can be varied from 80 deg. to 60 deg. from bottom center and the intake port timing can be varied from 45 deg. to 65 deg. Port shapes can be varied with inserts providing various entrance angles. The range of variation of compression ratio extends from 6 up to 16, and the engine can be operated either on the Otto or Diesel cycle.

A new method for measuring scavenging efficiency is used in this project, utilizing the fact that the B.m.e.p. produced from a given quantity of a known fuel-air mixture can be taken as a measure of the scavenging efficiency. In other words, by keeping the mass of mixture per stroke of the engine con-

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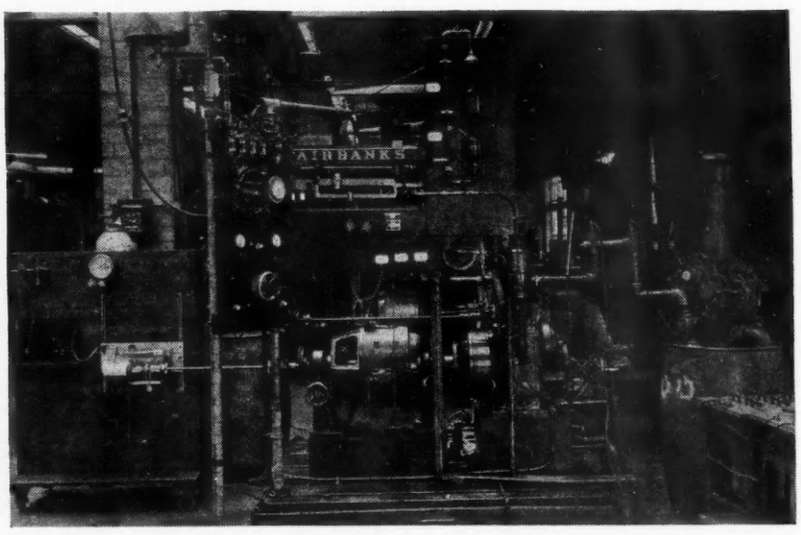

Cooperative Fuel Research engine coupled to a small electric dynamometer. Note the air motor on the right and the M.I.T. indicator, left, for obtaining indicator cards on the pressure-time basis.

Vehicle Performance

B. B. Bachman, in Discussing This Subject, Holds That the Overgeared Transmission Has Definite Virtues "Peculiar To Itself" . . . and Supplies His Reasons.

A PAPER on Fundamentals of Vehicle Performance by Merrill C. Horine of Mack Manufacturing Corp., presented at the Summer meeting of the S.A.E., drew a lengthy written discussion from B. B. Bachman, vice-president of engineering of the Autocar Co. Mr. Bachman's discussion dealt particularly with certain sections of Mr. Horine's paper and in order to make the discussion understandable, it is necessary to briefly review or abstract the portions of the paper referred to, those dealing with performance or ability factors and with the overgear. Such an abstract follows.

For practical purpose (said Mr. Horine) performance may be defined as the rate of maintenance of motion against the resistances arising from road surfaces, grades, snow, wind, and traffic. As a rule, the traffic resistance of the road surface is assumed to be 30 lb. per ton gross vehicle weight, and in view of the fact that most modern road surfaces have a tractive resistance of only about 20 lb. per ton, this errs on the safe side. Grades exert a uniform resistance of 20 lb. per ton, which must be added to the road resistance.

Snow has the effects of greatly increasing the tractive resistance and reducing the traction. In ordinary services it is quite impractical to attempt to provide in advance for this additional resistance, except by providing sufficient low-gear gradeability so that the wheels will lose traction before the engine stalls. Wind resistance is in reality made up of two items, viz., the resistance to motion in still air, and the addition to or reduction of this resistance by wind, according to its direction and velocity. On account of their great variability, the fact that air resistance is a minor factor below 40 m.p.h., and the fact that on a round trip the wind usually will be favorable over as great a distance as it is unfavorable, it is reasonable to ignore this item.

Of all the various impedances to performance, the greatest is undoubtedly traffic impedance, due to the presence of other vehicles on the highway moving in different directions and often at speeds different from that it is desired to maintain; the presence of stop signals and traffic officers on the road, and the existence of arbitrary speed limits imposed by police authority.

All performance arises primarily from the single factor of engine horsepower, and the potential performance always depends on the ratio of the engine horsepower to the gross weight of the vehicle or vehicles to be moved. In other words, it is possible to rate the ability of a motor vehicle simply in terms of pounds of gross weight per horsepower.

This, however, is not the complete story, for it is necessary to apply the horsepower to the rear wheels at speeds and gear reductions appropriate to the varying resistances to be overcome, and rates of acceleration required. This calls for the inclusion of a consideration of the torque characteristics of the engine, its governed speed, and the number and range of gear reductions available to the driver. The problem would be simple indeed if motor trucks operated under as nearly uniform conditions as elevators working in vertical shafts, railroad trains running on practically level tracks, or marine craft passing through a fluid of constant density. What makes the problem of specifying, providing, rating and checking of truck performance so difficult is that exceedingly variable resistances and impedances are encountered in highway transport.

In discussing any measurable thing, some gage or measure must be found for it. A term which has considerable currency is the so-called ability factor, which is understood to mean the tractive effort delivered at the rear tires divided by twenty times the gross vehicle weight in tons. The typical formula for the ability factor is

$$\frac{\text{Torque in lb-in.} \times \text{total reduction} \times \text{efficiency (in per cent)}}{\text{Gross vehicle weight in lb.} \times \text{Loaded tire radius in in.}} = \text{Ability Factor}$$

To get the grade ability from the result of this formula, it is necessary to subtract the equivalent of the road resistance in terms of grade resistance (0.015 for a road-resistance factor of 30 lb. per ton).

One drawback of this form of rating is that it is based on the peak torque of the engine, which occurs at an engine speed below that at which a competent driver will operate. It also provides no margin for loss of maximum torque between engine overhauls, and it is dependent on the manufacturer's rating, which may or may not be unduly optimistic. Furthermore, this rating takes no account of speed, and requires that it be worked out separately for each ratio and gear change. The Myers tractive-factor formula, which is virtually the same, suffers from the same limitation.

As a substitute it has been proposed that motor vehicle performance be expressed in terms of grade ability at 20 m.p.h., thus eliminating the factor of ratios, but still based upon peak torque or manufacturer's rated torque.

All three of the ratings so far mentioned fail in one respect—they do not permit direct comparison between different vehicles, except when certain very definite allowances are made, and they do not readily permit of direct interpretation in terms of the operator's problem. Accordingly, the S.A.E. in 1932 appointed a rating committee to develop a standard method of rating motor trucks, and one thing this committee did was to evolve a performance rating which yields an index figure known as the Performance Factor. This rating, which permits a direct comparison of different vehicles, and of the direct determination of grade ability and speeds under any given conditions,

by simple arithmetic processes, is obtained from the following formula:

$$\text{Performance Factor} = \frac{3.34 \times \text{Piston Displacement} \times \text{Governed r.p.m.}}{\text{Gross vehicle weight in lb.}}$$

If the performance factor is known, the grade ability at any given speed is

$$\text{Per cent grade} = \frac{\text{Performance Factor}}{\text{m.p.h.}} - 1.5$$

The speed at which a given grade may be climbed is

$$\text{m.p.h.} = \frac{\text{Performance Factor}}{\text{Per cent grade} + 1.5}$$

Although the formula was never adopted by the Society, it offers important advantages over any other known proposal, and it is being used to some extent by both users and manufacturers. As to its advantages, it gives an index figure against which no special allowances need be made; it takes account of both traffic effect and speed, and the result may be obtained equally easily in terms of grade ability and speed; it eliminates manufacturers' claims as to torque and substitutes therefore the generally obtained torque per cu. in. piston displacement. This torque, moreover, is that obtained at the governed speed and not the peak torque; and, finally, the formula is very simple to use.

The chief objection which has been made to the formula is that it is too complicated. This complaint arose from an error made in the presentation of the formula for analysis. The derivation of the formula was set forth in detail, and many careless readers assumed that all of this mass of figures constituted a part of the proposed rating, whereas only the three expressions given above are included in it. A more serious objection is to the large influence of the factor of engine speed, with the result that passenger-car types of chassis with ungoverned engines designed to run at speeds of 3000 r.p.m. and over, work out to abnormally high performance factors. This, however, is in agreement with the basic horsepower formula. The formula has been criticised also because apparently it does not take the gear reduction and the tire radius into account. However, these two missing factors are represented by the road speed.

Overgeared Transmissions

One of the most peculiar delusions with respect to gearing is that entertained by a surprising number of people concerning the effect on performance of overgearing in a transmission or auxiliary. The claims made are higher schedule speeds, higher fuel economy, and a greater range of ability.

Transmissions can produce a better schedule speed only by providing (1) a faster top speed, (2) a faster speed just under top, or (3) a quicker and easier shift. The first two are simple matters of ratio, and can as easily be provided in a direct-drive transmission as in an overgeared one. As everyone having experience with overgeared transmissions must realize, except where shifting is facilitated by having two speeds very close together, the overgeared shift is more difficult than the direct shift.

The only way in which a transmission can produce better economy or smoother running is to provide more nearly the ideal ratio in top speed, so that satisfactory road speed is obtained without racing the engine unduly. Here, again, it is obvious that the question is a simple matter of total ratio, and can as easily be secured one way as another. The impression that overgeared transmissions produce greater economy is no doubt due to the fact that the comparisons upon which such conclusions are based usually involve different total ratios as between overgeared and direct-geared transmissions, or comparisons of the two in connection with the same axle ratio, and so, of course, are not fair comparisons.

One of the chief drawbacks to the overgeared box is the necessity of using slower rear-axle ratios. This involves smaller pinions, whose pitch lines, of smaller radius, result in higher tooth pressures from the same input torque, and in addition, whose lesser number of teeth means a greater rate of wear. In the case of bevel gears, the greater the reduction, the flatter the angle on the ring gear, and hence the greater the distorting side thrust on that hard-worked member. This contributes to deflection and consequently to greater wear and lower efficiency; particularly where backing slippers come into play. Naturally, the higher pinion bearing speeds for equivalent wheel speeds mean more rapid wear of pinion bearings.

Mr. Bachman's Discussion

Those who intimately and frequently need to consider performance characteristics can use either the "Ability Factor" or the "Performance Factor." Both require the application of experience to make them truly useful. As the author points out, the "Ability Factor" takes no account of speed and the same answer can be obtained by using a large engine and a fast ratio or a small engine and a slow ratio. Carried to absurdity, a motor-cycle engine with a suitable reduction will provide the same "Ability Factor" as the largest engine available.

On the other hand, the question of engine speed, as the author indicates, assumes great importance in the expression for the "Performance Factor."

Anyone who is conversant with these two methods will automatically ask, when given an "Ability Factor," "at what vehicle speed?" When using the "Performance Factor," "at what engine speed?" With this information either expression can be useful; without it, comparisons are incomplete and misleading. In closing this part of my discussion, I wish to endorse all that Mr. Horine has said as to the basic relation of horsepower to weight and the proper function of the gear reductions in the transmission and axle.

However, in the latter part of the paper there are some statements with regard to the relative merits of direct and overgeared transmissions which I do not believe take all factors into consideration.

First, with regard to shifting, I do not admit that there is any greater difficulty in making the overgear shift. Admittedly, this is merely a statement in opposition to Mr. Horine's opinion and can not be proved in writing. Also, as both statements are opinions, each

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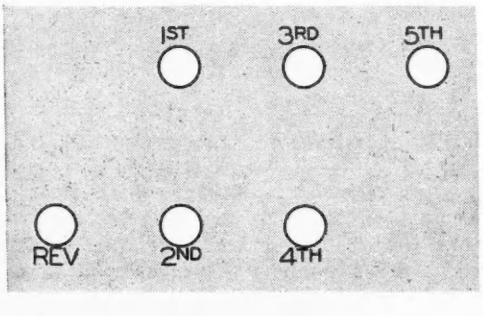


Gear Shift pattern referred to by Mr. Bachman in his discussion on transmissions.

Production Lines

Polishing all-steel bodies for the 1937 Plymouth models before application of enamel coatings. The grinding operation smooths joints where steel reinforcements have been welded to the outer steel shell

Body Dies

Although only a few cars will have entirely new bodies for 1938 there is considerable activity along that line. New bodies will be lower and much wider, at least six inches wider, in general. All-steel tops will predominate next year. The new bodies, together with detail changes on bodies to be continued in production, will constitute a rather handsome outlay for body dies and tooling. One independent already has authorized about $1,000,000 for body dies alone.

With Synthetic

Synthetic finish has come a long way during the past two or three seasons. Its use has been confined to the low-priced cars and commercial bodies and sheet metal and it has been thought that there was no prospect of extending this finish to higher-priced cars. We were told just this week that one of the car builders, an independent, is expected to make synthetic finish standard on the entire line of cars. We give you this for what it may be worth.

Zinc Grilles

It's pretty safe to say that more zinc radiator grilles will be found on '38 Show cars. The trend is to grilles made up of replaceable sections rather than the one-piece castings that were originally used. An interesting commentary on the die-cast grilles is the fact that with seasonal changes in styling the mold is a more certain method than the press die with its attendant try-outs and die fitting before a stamping can swing into production.

Public Opinion

There is little doubt that the Fisher Body Craftsman's Guild model car design competition entries represent a cross-section of the public's thinking along automobile lines. When we visited the exhibit of early entries at the General Motors Bldg. Auditorium, we were literally struck green with envy at the ingenuity and mechanical skill displayed by the youngsters. And who knows but what some of them may be the designers of our future cars.

As might be expected, a fair percentage of entries are influenced by the present-day cars, particularly such makes as — Olds, LaSalle, Lincoln-Zephyr, and Chrysler, with some reminiscent of the Cord. Quite a number are of tear-drop design with a stabilizing fin at the tail. And naturally, some incorporate rear-engine drive. Several of the more conservative, although novel models may well mirror some of the offerings for the '38 Show what with scanty running boards, "pontoon" type fenders, and general cleanness of line.

We feel quite satisfied in our own mind that Fisher Body has hit on a remarkably fine idea in this competition—one that may have more practical results than may appear on the surface. By all means take time out to view the exhibit in Detroit or at the nearest regional headquarters.

Gear Treatise

One of our friends—an outstanding gear expert and equipment manufacturer—has just distributed the first edition of a remarkable, spiral-bound book on current gear fabrication practice. It deals primarily with transmission gears but the principles apply to all manner of gearing. It discusses the selection of steels, heat-treatment, forging practice, and other practical phases of the subject. Much attention is given to gear blank design and the selection of gear cutting and inspection equipment. The first edition, running 2000 copies, is completely exhausted so that we can't promise you a copy immediately. However, if we get enough requests we can surely prevail upon our pal to start another edition going. Let's hear from you.

End-to-End

One of the biggest changes in battery practice will be seen on a number of cars this year. The battery is being made up with cells end-to-end resulting in a long, narrow rectangular case. The reason—these makes will mount the battery under the hood, on the dash panel.

Doggy Deck

An Eastern inventor has been to Detroit recently to demonstrate a novel rear deck arrangement that can be built into any production body. It's intended, of course, for coupes, convertibles, etc., with or without rumble seat. The design offers in the same package, a combination of rumble seat and luggage compartment by an in-

genious scheme of folding the seats and rolling them into the forward end of the compartment for luggage carrying. The device may be made with conventional sized door or with an extra large door panel. Body engineers, particularly, should be interested in looking it over.

Improves Wheels

Of interest to master mechanics and tool engineers is an article in the June issue of *Grits and Grinds*, describing Norton's new centerless grinder wheels. by the use of a new bonding material and specific selection of abrasive particles, Norton claims to have increased wheel life, decreased dressings, increased productivity, and improved surface finish. Get a copy of this issue as it contains, on page 8, a list of recommended wheels of the new type for many familiar operations.

Plastics Spread

There seems to be no question that molded plastics will make their boldest bid on 1938 cars. For years we have heard discussion of wider spread use of molded parts and this development undoubtedly will be fully realized this season. In addition to familiar applications, you will find molded pastics used for doors and trim of instrument panels, garnish moldings, and in combination with die castings on hardware.—J. G.

GEARS

from 1½ in. to 20 in. in diameter and clusters up to 30 in. length lapped on crossed-axes machine.

A crossed-axes gear-lapping machine which will lap gears ranging in size from 1½ in. to 20 in. in diameter and clusters up to 30 in. in length has been brought out by Michigan Tool Co., Detroit.

Change-over time for gears of same pitch and helix angle is about five minutes, while approximately 20 minutes is said to be ample for changing over for gears of entirely different characteristics.

The machine is a duplex type, with two laps which may be used either for lapping front and back side of gear teeth at the same time with the machine running in one direction only, or may be set to lap two separate gears simultaneously.

According to the manufacturer, the duplex type of operation makes possible reduction in lapping cost up to 50 per cent.

The machine is equipped with automatic cycle control mechanisms adjustable to permit setting the lapping cycle from five seconds to 20 minutes in both directions, the machine running first in one direction, then reversing, running the same legth of time in the other direction and then stopping for re-loading.

Two laps are located at either side of the work. The lap at the back of the machine is the driving member. Work is mounted either between centers or on an arbor. Centers are mounted on a reciprocating table, the stroke of which can be set to anything up to 5 in.

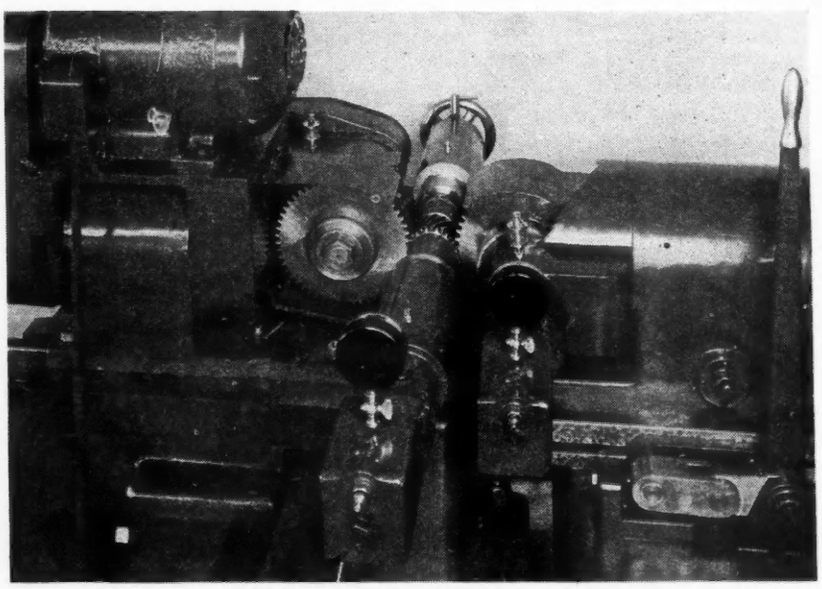
The work itself drives the second lap at the front of the machine, which lap in turn is provided with an adjustable hydraulic brake for establishing correct lapping pressure between laps and gear teeth.

Mounting of the laps is such that they may be set at varying angles to the axis of the gear being lapped. Further, both lapping heads are mounted on slides so that they may be moved to any position desired. Lapping two gears of different diameters simultaneously is thus made possible in a simple manner.

Primary adjustment for position of the laps is through hand wheel and screws. For unloading and after reloading a hand lever throws the front lap out of engagement and returns it to proper position, the lap head being brought up against stops for accurate re-locating.

Thus the driving lap is left at proper center distance, facilitating re-loading since the driving lap and gear to be lapped will be correctly meshed during loading. The front lap then will come back into mesh with the new gear exactly as it was taken out of mesh with the gear just removed.

The machine is equipped with pick-off change gears to provide any lap speed or table reciprocating speed that may be required.



Michigan crossed-axes gear lapping machine, which will lap gears ranging in size from 1½ in. to 20 in. in diameter and clusters up to 30 in. in length. Note how back and front tooth faces of a gear may be lapped without reversing the machine.

BEARINGS

The Newer Materials, Their Composition, and Lubrication Are Reviewed In This Abstract of a Paper by H. C. Mougey, General Motors Research Laboratory.

H. C. MOUGEY, of General motors Research Laboratory, Detroit, in a paper on on "The Newer Bearing Materials and Their Lubrication" (presented at the meeting of the American Petroleum Institute in Chicago) traced an outline of the history of wheels and bearings before taking up the particular subject covered by the title. He mentioned Isaac Babbitt, whose name has been connected with bearing metals for nearly a century and pointed out that, contrary to the general belief, Babbitt did not invent the white-metal composition that usually goes under his name. Babbitt took out a patent on a Journal Box (U. S. patent No. 1252), on July 17, 1839; it covered "the making of the boxes for axles and gudgeons, in the manner above set forth; that is to say, by the casting of hard pewter, or composition metal, of which tin is the basis, into said boxes, they being first prepared or provided or not with rims or ledges, and coated with tin, as herein described and made known."

Since Babbitt's time many other bearing compositions have been invented, some of the most important of which are listed in Table I.

Mr. Mougey said two theories had been advanced to account for the bearing properties of certain alloys. According to one of these, a bearing metal must be a combination of hard crystals in a matrix of softer material; the hard crystals are supposed to carry the load, and the softer matrix is supposed to permit deformation of the bearing so as to permit a more nearly uniform distribution of the pressure. The author said he believed the "hard crystal and soft matrix" theory to be incorrect and that its acceptance had greatly retarded the development of bearings. It is true that certain soft metals, such as lead, tin and cadmium, although good in anti-friction and non-scoring properties, are low in mechanical strength, and an increase in mechanical strength may be obtained either by bonding these materials in thin layers to stronger materials or by combining them with certain materials to give a fine mechanical mixture of soft metal and hard crystals. However, it is the resulting combination of properties, and not the hard and soft crystal method of obtaining these properties, that is important.

According to the second theory the crystal structure is of little or no importance, but the bearing must have a combination of properties so that it will resist the forces to which it may be subjected in service. These properties are tabulated in Table II.

The particular combination of properties required by a bearing depends upon the forces to which the bearing is subjected. Leaded bronze, of the composition copper 88, tin 4, lead 4, and zinc 4, is excellent for the bearing for the small end of an automobile connecting rod; and steel-backed, high-tin-base babbitt bearings are in general use for the large ends of connecting rods—but very unsatisfactory results would be obtained if these bearings were reversed, and the leaded bronze of the above composition used for the big end and the babbitt for the small end.

Under certain conditions other properties or combinations of properties may be important. Canvas impregnated with bakelite is coming into general use for certain very severe bearing conditions, such as some of the bearings in steel mills; but this material is unsatisfactory for automobile connecting-rod bearings for high-speed operation, because the heat generated at the bearing surface cannot be dissipated rapidly enough, and the rubbing surface of the bearing soon chars.

In general, a bearing metal need not have all of the properties in Table II; it requires only the ones that will enable it to resist the forces to which it will be subjected in service. Tin-base babbitt (SAE 11) is in general use in large-end connecting-rod bearings; but SAE 11 is very low in mechanical strength, in melting point, and in fatigue resistance. However, it is excellent in its bonding characteristics, and the combination of a steel back bonded to a very thin lining of SAE 11 produces a bearing which is much superior to a straight SAE 11 bearing in mechanical strength and fatigue resistance. The anti-friction characteristics of a steelback babbitt-lined bearing are so good that the temperature rise due to friction may be low enough so that the low melting point of the SAE 11 is not fatal. Such a bearing is good in non-scoring characteristics, in conformability, in embedability, and in corrosion resistance.

However, most tin-base and lead-base babbitts tend to lose their strength very rapidly at elevated temperatures. This tendency is shown by the curves in Fig. 1. In modern automobile engines this loss in strength, due to higher crankcase temperatures, is so

TABLE I
Some Bearings and Their Composition

Bronzes (Or High Copper Alloys)

	Copper	Lead	Tin
1870—Dick	80	10	10
1892—Dudley	77	15	8
1900—Clamer and Hendrickson	(73)	20	7
		(minimum)	(maximum)
1904—Clamer (Patent No. 769,337). A stiff back with a lining of high melting point. (This is the original steel-back copper-lead bearing.)			

High Lead Alloys

1905—"No Heet" .....Lead		96-99.5
	Sodium	4- 0.5
1915—Ulco metal, Frary metal, Mathesius, Lurgi Lagermetall, Bahumetal, Satco, etc. (lead hardened with alkali and alkali-earth metals).		

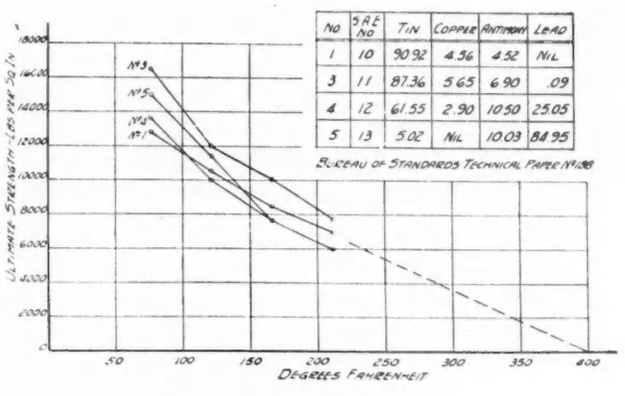
Cadmium Alloys

1909—Touceda, Patent No. 934,637 .....Cadmium		95-99.5
	Magnesium	5- 0.5
1933—Schwartz and Phillips, Patent No. 1,904,175 ....Cadmium		93-99.75
	Nickel	7- 0.25
1935—Smart, British Patent No. 436,633 .....Cadmium		97.0-98.0
	Copper or Nickel	0.25- 0.50
	Silver	1.75- 2.50

TABLE II
Bearing Properties

1. Mechanical strength
2. Bonding characteristics
3. Melting point
4. Fatigue resistance
5. Anti-friction characteristics
6. Non-scoring characteristics
7. Conformability
8. Embedability
9. Corrosion resistance

serious that many attempts are being made to replace SAE 11 with other materials. In the case of connecting rods for airplane engines, SAE 11 is already practically obsolete, and other bearing materials that have higher strength at elevated temperatures are in general use. Lead and cadmium have higher melting points than tin; and, although these metals do not offer as much increase in strength at elevated temperatures as might be desired, they may have enough advantage over tin—especially in borderline cases—to make all the difference between success and failure. High-lead-base bearings and cadmium bearings are coming into general use for such types of service as connecting rods for diesel engines.



No	SAE No	Tin	Copper	Antimony	Lead
1	10	90.92	4.36	4.52	Nil
3	11	87.36	5.65	6.90	.09
4	12	61.55	2.90	10.50	25.05
5	13	5.02	Nil	10.03	84.95

BUREAU OF STANDARDS TECHNICAL PAPER No 128

Fig. 1—Curves showing tendency of tin-base and lead-base babbitts to lose their strength rapidly at elevated temperatures.

In trying to replace SAE 11 it is very easy to get a material that will be superior in one or two respects, such as mechanical strength or high melting point; but such a bearing may be lacking in other important respects, such as corrosion resistance or anti-friction characteristics or non-scoring characteristics. When used in crankcases with corrosive oils or with oils that become corrosive due to oxidation of the oils, certain high-lead or cadmium bearings may fail very rapidly due to corrosion. Attention has previously been called to the fact that the alloy,-copper 88, tin 4, lead 4, and zinc 4, is unsuitable for large-end connecting-rod bearings in automobile engines. This is because it will cause scoring of the crankshaft under high-speed operating conditions, although it will not score the shaft under sufficiently low-speed operating conditions. It is due to the low rubbing speed at the small end of the connecting rod that this alloy can be used for a piston-pin bearing.

Scoring

This scoring problem is one of the most important in developing connecting-rod bearings; but, unfortunately, we have very little reliable information as to why certain metals score and others do not.

Bowden and Ridler have reported in the *Proceedings of the Royal Society* on some work that they did to determine the temperatures of the surface layers of bodies during sliding. The surface temperature was measured by using the rubbing contact of two different metals as a thermocouple, and determining the electromotive force generated on sliding. Experiments showed that the local temperature—which depended upon load, speed, coefficient of friction, and thermal conductivity—might be surprisingly high, reaching more than 1000 deg. C. (1832 deg. F.) in some cases. With lower-melting-point metals, the melting point of the metal was the maximum temperature that could be reached. In tests on lubricated surfaces they obtained similar results. For example, a polished metal surface, well lubricated with "Castrol XL," and running smoothly with a low coefficient of friction, showed a surface temperature of over 600 deg. C. (1112 deg. F.). This high temperature was localized at the sliding surface, the mass of the metal was at room temperature, and there was no evident sign of heating.

A joint research committee of the A.S.T.M. and the A.S.M.E. has been working on the "Effect of Temperature on the Properties of Metals." In this work the seizure of metals at elevated temperatures has been studied. The following sentences are taken from a condensed report of this committee.

"One of the causes of failure of metals at high temperature is seizure, the incipient welding together of two metal surfaces in contact. . . . While perfectly matching surfaces will weld readily, in order to bring surfaces of ordinary smoothness of finish into molecular contact it is usually necessary that one surface at least be fairly plastic and be pressed against the other so as to force them into molecular contact. In many such cases plasticity is brought about by elevated temperature, so that the seizure problem is quite generally a high-temperature problem. . . . Unless they are soluble in the solid metal at the temperature in question, oxide and other non-metallic films prevent metallic contact of the coating surfaces, and may thus prevent seizure. A film of oil, or even of adsorbed gas, will likewise prevent contact."

The findings of this committee are in accord with the results of work at the National Bureau of Standards, in which it was found that under certain conditions of load and rubbing speed, with steels of certain properties, metal-to-metal contact would occur, followed by seizing, welding, and very rapid wear. However, if the test conditions were modified somewhat, adherent oxide films would form on the surfaces of the steel; and, under exactly the same conditions of load and rubbing speed, these oxide films would prevent metal-to-metal contact; and, as a result, there would be no signs of seizing or welding, and the rate of wear would be extremely low.

In the report of the joint A.S.T.M.-A.S.M.E. committee descriptions are given of various testing machines which are used to determine the non-scoring characteristics of metals, but experience indicates that it is difficult to obtain check results with such machines and to correlate the results with performance in service. For this reason a test in an engine under actual service conditions is the only true test of non-scoring; and, since the requirements in different engines may be different, a bearing that scores in one engine may be non-scoring in another engine of slightly different design or operated under different conditions.

Fatigue Resistance

Since with clean oil and in the absence of corrosion or scoring troubles, bearings fail by lack of resistance to fatigue, and since resistance to fatigue in an engine cannot be determined by the conventional tension, compression, or impact tests, and since the quality of the oil usually has little or nothing to do with resistance to fatigue, it is very important in developing bearings to be able to measure resistance to fatigue. This can be done by operating the bearings in an engine under very high-speed, high-temperature, and high-load conditions. This actual engine test must always be made as the final test before drawing definite conclusions as to resistance to fatigue. However, under these severe conditions, other parts of an automobile engine are also subject to failure, and it is not a simple matter to make fatigue tests in engines. Consequently,

for preliminary work, a laboratory testing machine is desirable.

The loading on connecting rods is quite different from the loading on bearings used for line shafts, etc. In the case of a connecting-rod bearing the load travels around the inside of the bearing; and, on account of the lightness of the connecting rods, a certain amount of deflection of the bearings usually occurs.

Testing Machine

At the General Motors laboratory use is made of a bearing testing machine which consists essentially of a fairly long shaft mounted in pedestal bearings and which can be driven by belt from an electric motor. A diagram of the shaft with its bearings and the connecting rods mounted on it is shown in Fig. 2. The eccentric weights A,A tend to make the shaft "bow out," thus putting a rotating load on the connecting-rod bearings B,B. The connecting rods are spaced at an angle of 90 deg. and are held with piston pins at the small ends C,C. The eccentric weights D,D are for the purpose of counterbalancing the weights A,A, so that the testing machine as a whole may not vibrate. Oil is fed to the bearings by holes in the shaft E, so that the bearings are lubricated just as they would be in an engine.

The temperature of the oil is controlled by electric heaters immersed in the sump. The temperature of the bearings is determined by thermocouples embedded just beneath the surface of the babbitt, and the temperature of the oil in the sump is controlled so as to maintain the bearings at the predetermined temperature. This bearing temperature is usually 174 deg. C.-176 deg. C. (345 deg.-349 deg. F.). The temperature of the oil in the sump is usually between 135 deg. C. (275 deg. F.) and 149 deg. C. (300 deg. F.) since the difference in temperature between the oil in the sump and the bearing depends upon such factors as load, speed, bearing clearance, oil, viscosity, coefficient of friction of the bearing, etc. The test machine is usually operated at a speed of 4500 r.p.m., with the eccentric weights adjusted to give a calculated bearing load of 1400 lb. per sq. in. projected area. If the bearings are not resistant to corrosion, the test must be made with an oil that will not develop corrosive acids on oxidation under the test conditions. If it is desired to test the performance of the bearings with corrosive oils, then either 1 per cent of oleic acid is added to the lubricating oil, or corrosive acids are allowed to form as the result of oxidation of the oil in the test machine. General Motors Laboratory has standardized on S.A.E. 30 oil, although there is no measurable difference in bearing life in engines over the range of viscosities of from 10-W to S.A.E. 40, provided the lubricating system in the engine can keep the bearings supplied with oil under all conditions.

By means of this machine it is possible to compare the fatigue resistance of different bearing materials, making the tests in the actual connecting rods in which the bearing material is to be used. Since the details of construction of the rod and of the bearing greatly affect the resistance to fatigue, an inferior bearing material in a well-designed rod may be superior to a better bearing material in an inferior rod. For this reason it is impossible to give definite figures as to the relative merits of different bearing materials, and each engineer tries to get the best all around results in his own engine.

Conformability is the property of a bearing that permits it to deflect or distort enough to give a more uniform distribution of pressure. This result may be accomplished by design of the bearing or by composition of the bearing alloy, or both. The cap of an automobile connecting rod is subject to much higher calculated loads than the part of the bearing in the main part of the rod; but as the cap is usually sufficiently flexible to permit a more uniform distribution of the load, the life of the cap half of the bearing is usually much greater than that of the rod half of the bearing.

Embedability is the property of the bearing that permits the embedding of small particles of dirt in the bearing, thus decreasing the abrasive action of these small particles. Examination of a used babbitt bearing will usually show many small particles of iron, or other hard materials; but these have been embedded in the bearing to such an extent that they no longer tend to cause abrasion.

Corrosion Resistance

Corrosion resistance is a property that may be very important. Ordinary mineral oil, regardless of the crude or method of refining, is usually very low in acidity or corrosive tendencies. However, under certain conditions, as the result of oxidation—especially at elevated temperatures — organic acids that probably are quite similar to oleic acid may be formed. Lubricating oils differ greatly in their tendency to form acids by oxidation under high-temperature conditions. All crudes contain varying amounts of inhibitors that decrease the tendency of oils to oxidize, but these inhibitors may be removed from the oil to a greater or less extent by the various refining methods. As a result, a year or so ago, many of the more highly refined lubricating oils were subject to oxidation at high crankcase-oil temperatures, with the resulting development of acids that would corrode certain bearing materials such as cadmium or some of the high-lead materials. This subject is getting to be better understood by oil chemists and, as a result, many oil companies are now in production on lubricating oils that, although very highly refined, are very resistant to the development of corrosive acids.

It is evident that there are three solutions to the problem of corrosion of bearings. These solutions are:

1. Develop oils that will not form corrosive acids, even under severe operating conditions.
2. Decrease the crankcase temperatures to such an extent that all oils will be free from oxidation.
3. Use bearings that are not subject to corrosion, even with acid oils.

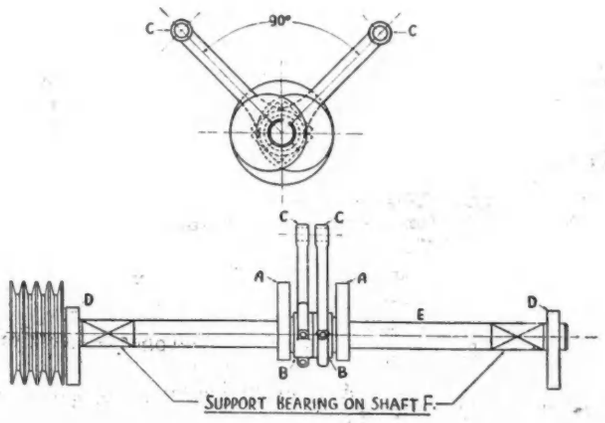


Fig. 2—Diagram of bearing testing machine in use at the General Motors Research laboratory showing the shaft, pedestal bearings, and connecting rods.

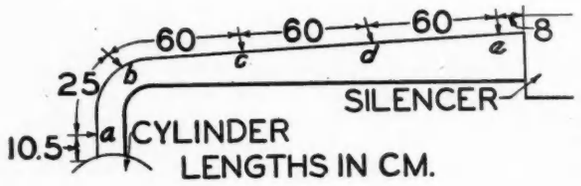


Fig. 1 — Diagram of exhaust pipe showing location of points at which pressure measurements were taken.

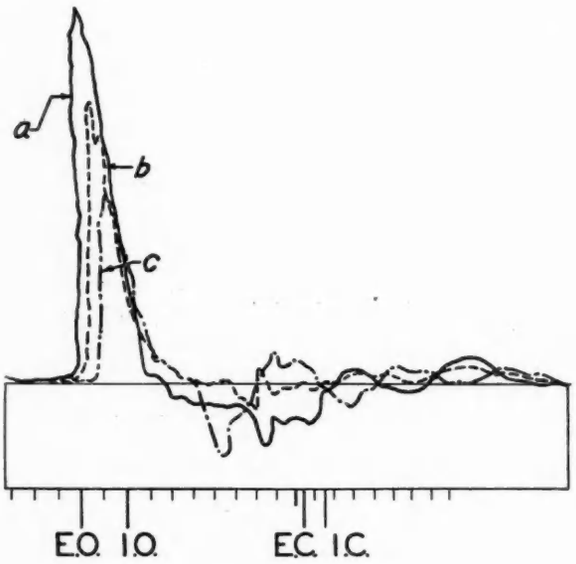


Fig. 2—Cathode-ray oscillograph records of pressure variation at stations a, b, and c marked off on the exhaust pipe as indicated in Fig. 1.

Two-Stroke Engine Investigations

Details of Some Tests Made at King's College, London, On Kadenacy Units Which, Providing Timing and Port Design Are Correct, Can Be Operated Without Scavenging Pump, Inlet and Exhaust Pipes.

SOME new ideas on the operation of two-stroke engines have been introduced by M. Michel Kadenacy, whose British patents are to be exploited by Armstrong-Whitworth Securities Co. of London. M. Kadenacy observed that immediately upon the opening of the exhaust port of a two-stroke engine there is a very rapid escape of gases, which results in a partial vacuum in the cylinder. If the inlet port or valve is suitably timed, new charge enters the cylinder behind the escaping burnt gases. With suitable timing and port design, such an engine can be operated without scavenging pump, inlet and exhaust pipes.

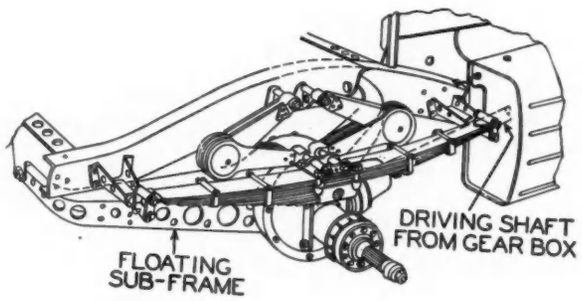
Some tests on Kadenacy engines were made at King's College, London, and at the Armstrong-Whitworth works at Slough by Dr. S. J. Davies, who reports on these tests in *Engineering*. To prolong the period during which a vacuum exists in the cylinder following the opening of the exhaust port, the engine is provided with a simple exhaust pipe. Tests made on a single cylinder experimental apparatus with a bore of 61 mm. and a stroke above the upper edge of the exhaust port of 56 mm., showed that 56 per cent of the contents of the cylinder passed out through the exhaust port at a speed vastly higher than those accepted as possible in engine practice and that, following this rapid exit, a vacuum of 8 lb. per sq. in. was left in the cylinder. The exhaust port had a depth of 4 mm. and a circumferential width of 50 mm., making its maximum area 2 sq. cm. The compression ratio was 5.15.

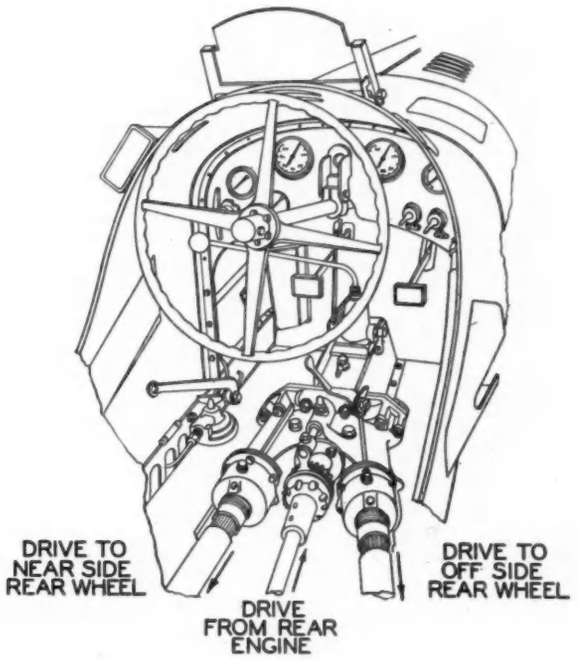
Another test was made on a two-stroke gasoline engine of 61 mm. bore and 85 mm. stroke, with piston-controlled inlet and exhaust ports. The engine had no exhaust pipe but was fitted with non-return valves over the exhaust ports. The carburetor and ignition equipment were of conventional design. The crank angle corresponding to the opening of the exhaust port was 125 and that of the intake port 102 deg. Maximum opening areas of the two ports were 7.2 and 11.0 sq. cm. and mean opening areas, 3.94 and 8.2 sq. cm., respectively. The engine ran at 2664 r.p.m. and developed 3.8 b.h.p., with an air consumption of 112.6 cu. cm. per cycle.

Tests were also made with a light cursor in a glass exhaust pipe. It was found that upon the initial explosion the cursor moved rapidly in the direction toward the outlet and then returned toward the cylinder, its final position being about 10 cm. nearer the outlet of the pipe. The movements of the cursor were also recorded photoelectrically.

Records of pressure variation were made with a cathode-ray oscillograph of various points *a*, *b*, *c*, *d*, *e*, along the exhaust pipe (Fig. 1). A series of diagrams taken at these different points is shown superposed in Fig. 2. When these diagrams were taken the engine was running at 1250 r.p.m. and developin a b.m.e.p. of 66 lb. per sq. in. There is no apparent lag in the arrival of the pressure front at *a;* at *b* the lag is 3 deg., at *c* 10 deg., at *d* 24 deg., and at *e*, 33 deg. The maximum pressure was greatest at *a*, it decreased down to *d* and then increased again to *e*. The interval between the initial front and the point at which the pressure next reaches a maximum decreases from 110 deg. at *a* to 80 deg. at *c*, 72 deg. at *d*, and 66 deg. at *e*. This is consistent with the suggestion that the exhaust gases leave the cylinder as a compact mass, with a definite front, which is propagated rapidly along the pipe and impinges on the external gases, this action being followed by a return of the gases toward the cylinder after impact.

Tests made by Iowa Engineering Experiment Station indicate that the gasoline consumption of automobiles is about 10 per cent greater on untreated gravel roads than on concrete-paved highways. The gasoline mileage was found to average 22 per cent less at 52 m.p.h. than at 33 m.p.h. Oil consumption was found to be about five times greater at 52 than at 33 m.p.h. Tire wear was considerably greater on untreated gravel than on concrete pavement, about 2.7 times as great at 33 m.p.h.





Two-Engined Car

Racing Vehicle of Alfa Romeo Type With Independent Springing at the Rear; 8-Cyl. In Line Power Plants

ALFA-ROMEO, the well-known Italian firm, has been racing a two-engined car for some time and Nuvolari established a road record of 200.78 m.p.h. with it. A car of this type with somewhat smaller engines has been imported into England and some interesting details of its design are given in *The Autocar*, from which the accompanying sketches are reproduced.

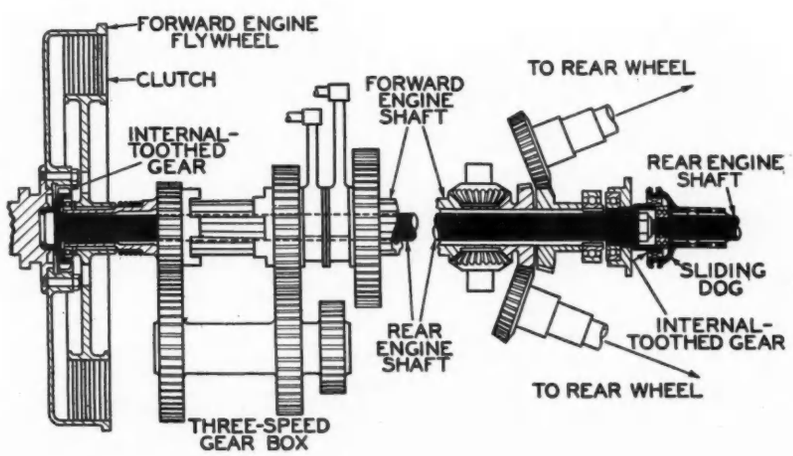
Each of the two engines is an eight-cylinder in line, of 68 mm. bore and 100 mm. stroke (2.677 by 3.937 in.) making the total displacement of each engine 177 cu. in. Each engine has two four-cylinder blocks cast of aluminum, with non-detachable head and dry liners. The valves are in the cylinder heads and are actuated by two camshafts driven from the crankshaft through gearing at the middle of its length. Each valve is provided with three valve springs.

At the side of the crankcase are located two Roots-type blowers which draw from the carburetors and supply mixture to the cylinders through an outside piping. The crankshaft is made in two parts and has plain main and crankpin bearings. Lubrication is by the dry-sump system. In the latest design, stiffening ribs have been added to the ends of the engine block and the sides of the water jackets have been provided with detachable plates.

The forward engine drives through a disk clutch and a four-speed transmission. The rear engine, which is of the same design, is mounted behind the driver's seat, the bellhousing being at the rear. At its forward end, the crankshaft of this engine carries one-half of a large flexible coupling which connects it to a driving shaft extending forward under the driver's seat and ending with an internally-toothed cup (see illustration). A shaft projects from the rear end of the transmission and is toothed to receive this cup. The front engine drives the gearbox normally, but the rear engine drives a shaft carried right through the driven, driving, and clutch shafts and bolted to the flywheel of the front engine. At the back of the transmission is arranged a mechanism comprising a differential and two pairs of bevel driving gears, from which shafts extend at an angle with the car axis to other bevel-gear pairs at the driving-wheel hubs.

By means of a hand control the toothed coupling of the rear engine can be disengaged, in order to start the front engine alone. When the friction clutch is disengaged it frees the transmission from both engines simultaneously, as required for shifting gears.

Another interesting feature of this racer is the independent springing at the rear. With an engine at the rear of the frame, the normal rear axle could not be used. Each rear hub is mounted on a stub axle extending from a pivoted pressed steel arm which runs almost parallel with the side member of the frame, so that it can move in an arc of a circle. Semi-elliptic springs are used, slung out from the frame, and the free end of the pressed steel arm is connected to the middle of the spring. At the front the normal independent suspension is used, each wheel being mounted on a beam moving against a coil-spring buffer in a hydraulic cylinder, with a special form of extra friction damper.—*The Autocar.*



Self-Holding Tapers

New Series Approved by American Standards Association Embraces 19 Sizes Ranging from 0.239 to 12 in. in Diam.

A NEW, simplified series of self-holding or "slow" tapers has been approved by the American Standards Association. It embraces 19 different tapers ranging in size at the large diameter or gage line from 0.239 to 12 in. This new series of tapers is based in part on some of the more widely used older taper series and comprises the following:

(a) Brown & Sharpe tapers Nos. 1, 2, and 3, each with a taper of ½ in. per ft., but renumbered according to the decimal diameter at the gage line, respectively, 0.239 in., 0.299 in. and 0.375 in.

(b) Morse tapers No. 1, 2, 3, 4, and 5, with the taper per foot, as now correctly computed, rounded to three decimal places. These tapers will bear the original Morse numbers.

(c) A new taper between Nos. 4 and 5, designated No. 4½, based on a slope of 0.623 in. per ft., with a diameter at the gage line of 1.500 in. This taper has the same slope as the Morse No. 4 and fills the long-felt gap between Morse tapers Nos. 4 and 5.

(d) An entirely new series of tapers of large size, each with a slope of ¾ in. to the ft., each designated by the number of tenths of an in. in the diameter at the gage line, and ranging in size of gage-line diameter from 2 in. to 12 in. The table on this page sets forth the essential dimensions of the new series.

What is believed to have been the first attempt to standardize tapers for tool-holding or work-holding devices was made by the Brown & Sharpe Manufacturing Co. in 1860, when the well-known Brown & Sharpe taper standard was evolved. These tapers had a slope of ½ in. per ft. and covered a range of 0.2391 in. to well over 3 in. Two years later, in 1862, the Morse Twist Drill & Machine Co. developed a series of eight tapers, each with a slope of approximately ⅝ in. to the ft.

Both of these systems came into wide use, both here and abroad, and the Morse system particularly had been so widely adopted when engineering standardization first was taken up on a national or international basis, that it became part of practically every national and international standard series of tapers so far adopted.

The work of the committee that developed this new standard began as far back as 1926. From the beginning the members of the committee divided into two groups, one holding that a new, uniform and consistent series of tapers should be adopted, to eliminate the errors and inconsistencies of the older series, while the other group held that the Morse series had become a *de facto* international standard which would have to be recognized regardless of any imperfections. The series finally adopted represents a compromise, which is justified by the fact that any entirely new series would have immediately obsoleted all machine-tool spindles.

American Standard Self-Holding Tapers
Basic, and Certain Calculated Dimensions

No. of Taper A	Taper[1] per Foot B	Diameter[1] at Gage Line C	Diameter[2] at Small End D	Length[2] Gage Line to Small End E	Means of Driving and Holding: Tongue Drive with Shank Held in by Friction	Means of Driving and Holding: Tongue Drive with Shank Held in by Key	Means of Driving and Holding: Key Drive with Shank Held in by Key or Draw Bolt
.239	0.500	0.239	0.200	⅝			
.299	0.500	0.299	0.250	1⅝			
.375	0.500	0.375	0.312	1½			
1	0.600	0.475	0.369	2⅛			
2	0.600	0.700	0.571	2⅝			
3	0.602	0.938	0.778	3⅛			
4	0.623	1.231	1.020	4⅛			
4½	0.623	1.500	1.266	4½			
5	0.630	1.748	1.476	5⅛			
200	0.750	2.000	1.703	4¾			
250	0.750	2.500	2.156	5½			
300	0.750	3.000	2.609	6¼			
350	0.750	3.500	3.063	7			
400	0.750	4.000	3.516	7¾			
500	0.750	5.000	4.422	9½			
600	0.750	6.000	5.328	10¾			
800	0.750	8.000	7.141	13¾			
1000	0.750	10.000	8.953	16¾			
1200	0.750	12.000	10.766	19¾			

All dimensions are given in inches.
[1]Taper per foot and diameter at gage line (columns B and C) are basic dimensions.
[2]Dimensions in column D are calculated to three decimal places from the basic dimensions and are for reference only.

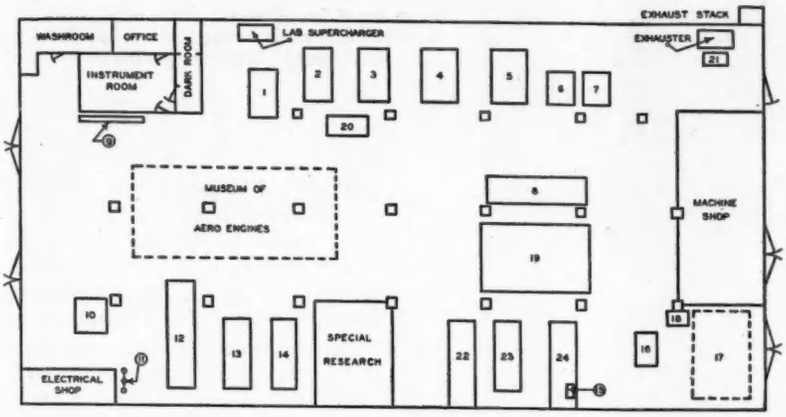
Germans Develop Direct Mechanical Transmission for Railcars

A DIRECT mechanical transmission for railcars, etc., which has the advantage that there is no interruption in the drive when gears are changed, has been developed in Germany under the name Ardelt. There are a number of pairs of gears connecting two parallel shafts, the pinion of each gear being free on its shaft but adapted to be secured thereto by means of a separate, multiple-disk-type friction clutch. These clutches are of special design and will disengage automatically as soon as the driven gear tends to overrun the driving pinion. This is accomplished by mounting the hub of the clutch drum on an extension of the driving pinion provided with helical splines. As soon as a higher gear is engaged, the clutch of the lower gear is automatically released, and this gear idles. To make the engine available for use as a brake, a locking device is provided. The transmission appears to possess special advantages for use with Diesel engines and on line with severe grades, where continuity of driving torque is particularly desirable.

New Method for Eliminating Vibration Effects on Strain Gage Readings

A NEW method of eliminating the effects of vibration on the readings of strain gages has been developed by W. M. Bleakney of the National Bureau of Standards and was described by him in the *Journal of Research* for June. (RP 1005). It consists in so adjusting the ratio of stiffness to inertia of the parts of the gage that the deformations caused by inertia are compensating. The indication of the gage may thus be made independent of any acceleration of the gage as a whole.

This method is being used in the design of an electro-magnetic strain pick-up unit for recording strains in aircraft in flight, which is being developed for the Navy. The Massachusetts Institute of Technology and the Sperry Gyroscope Co. are collaborating in this work.



Schematic Floor Plan Showing Location of Equipment in the Sloan Automotive Laboratory at the Massachusetts Institute of Technology.

The building is approximately 80 ft. wide and 160 ft. long. Facilities, in addition to those indicated on the diagram, include service connections at each test stand for water, steam, air, three kinds of fuel, air under pressure for supercharging and low-pressure exhaust for simulating altitude conditions. Equipment numbered on the schematic floor layout is identified as follows:

1. Single-cylinder, two-stroke engine arranged so that valve timing, exhaust and inlet timing, exhaust and inlet passage shape, and compression ratio may be varied while the engine is operating.

2. Dynamometer equipped with reduction gear for testing multi-cylinder engines up to 5000 r.p.m.

3. Sleeve-valve single cylinder engine with 6 in. bore and 8 in. stroke which can be set up as a Ricardo type Diesel or for operation on the Otto cycle.

4. N.A.C.A. universal type single-cylinder engine.

5. Single-cylinder universal crankcase which will accommodate either air-cooled or water-cooled cylinders.

6. L-head, single cylinder engine arranged for flame speed studies.

7. C.F.R. Engine with Waukesha Comet head, or standard spark-ignition head.

8. Small wind tunnel for research in heat transfer from various kinds of surfaces to air at high velocity.

9. Glass combustion tube and apparatus for studying effect of sound, etc., on rates of gaseous combustion.

10. Equipment for calibrating vibration measuring devices.

11. Mechanical oscillator for solving problems in vibration by means of a model.

12. Multi-cylinder engine connected to water-brake. At present, used for studying effect of intake pipe lengths on volumetric efficiency.

13. Multi-cylinder engine with floating power suspension, arranged for vibration testing.

14. Multi-cylinder engine connected to water brake and now set-up for alcohol fuel research.

15. Equipment for calibrating pressure indicator.

16. C.F.R. engine for classroom work with provision for measuring air and heat rejection to water jacket.

17. Pit for future installation of chassis dynamometer.

18. M.I.T. machine for converting pressure-time indicator diagrams to pressure-volume basis.

19. Cowdrey brake testing machine.

20. Two-element cathode ray, high-speed oscillograph. Instrument is capable of getting photographic record with 70,000 in. per sec. spot speed. Now being used for study of pressures in engine cylinder during combustion and the rate of change of pressure within the cylinder.

21. Arrangement for determining resistance air flow of intake and exhaust ports.

22, 23, 24. Several additional bed plates are provided for mounting equipment.

M.I.T. Laboratory

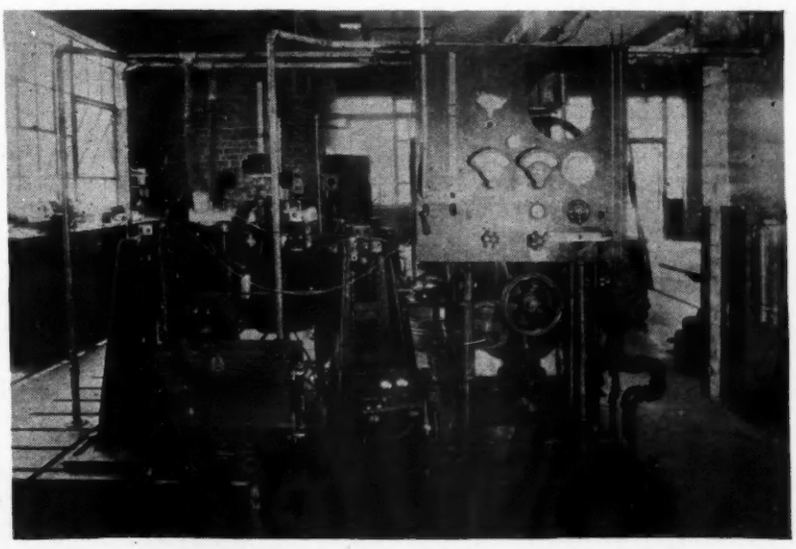
(Continued from page 116)

stant (which is the same as maintaining the available B.t.u. input constant) output varies directly with scavenging efficiency, providing thermal efficiency also remains constant. Illuminating gas was selected as the best fuel for the purpose. In this experiment, the difference between actual B.m.e.p. and the m.e.p. required to compress and deliver the scavenging air is used as the measure of scavenging efficiency.

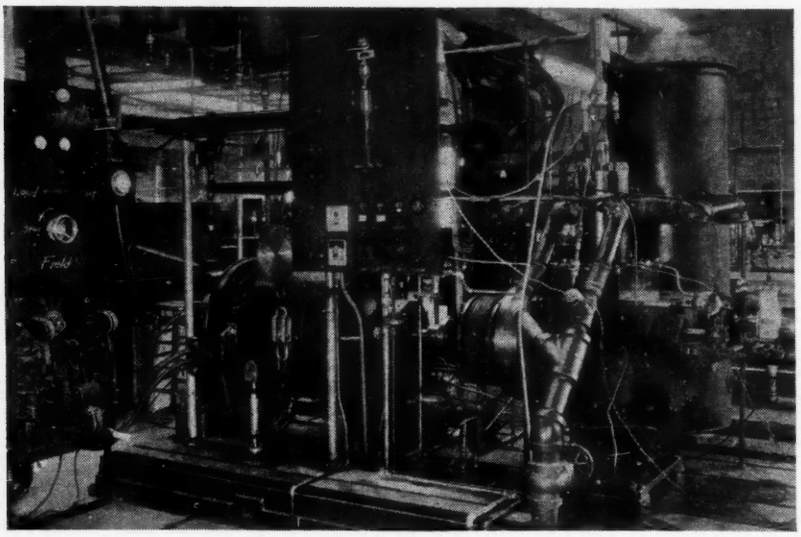
The test procedure is to set intake ports at various heights and to take readings at various exhaust port timings. Before each run, air and gas flow are adjusted to give 40 per cent excess scavenging mixture and the correct fuel-air ratio. Port timing and port shapes are the variables for each test run.

The result of the work will be published by the National Advisory Committee for Aeronautics.

A rather unique project recently un-



Vibration measuring equipment, set up to measure vibration characteristics of multi-cylinder engine. Note the water brake on the right



M.I.T. single-cylinder test crankcase with single-sleeve-valve cylinder. 6 in. bore by 8 in. stroke. The equipment is used for both compression ignition and spark ignition research

dertaken by an undergraduate student was an investigation which sought to determine whether sound waves impressed on a combustible gaseous mixture has an effect on the rate of combustion of the mixture. Apparently this is the first work which has been done on studying effect of sound on combustion. The problem was selected as a research project for two reasons: the possibility that the phenomena might influence detonation occurring in an internal combustion engine and also that knowledge of the influence of sound on combustion might clarify understanding of the mechanics of combustion.

The apparatus used for making the study consisted mainly of a glass tube 12.25 ft. long with an inside diameter of 2 in. The tube was charged with combustible mixture by introducing the mixture into the tube under slight pressure against an aluminum plunger. During each run, the end of the tube opposite the ignition end was sealed by a sound producing diaphragm and the ignition end was open. Time required for flame to travel the distance between two points was measured electrically.

It was found that when sound was produced by a beat frequency oscillator-amplifier - loud speaker arrangement, that intensity of the sound produced by the apparatus was too low to make the arithmetic mean of the runs made with maximum sound intensity obtained differ from the arithmetic mean of the runs made without sound by an amount greater than the calculated probable error. With the automobile horn as a source of sound, however, it was found that sound was of sufficient intensity to appreciably slow down the flame speed.

Several months ago students C. H. Fager and E. A. Brittenham, Jr., conducted a series of tests for the purpose of determining the effect of an exhaust-port heat shield on the heat given up to the exhaust port of an aircraft type cylinder. They were able to conclude from the experimental data that heat saved would be appreciable if welding technique were developed so that a shield could be welded properly to the valve seat. It was pointed out that one practical application would be installation of a sleeve in an air-cooled engine, possibly permitting operation at leaner mixture with resulting economy.

Test equipment used for this project was a Liberty 12-cylinder with 5 in. bore and 5.5 in. stroke, the water jacket being welded to form three separate jackets. One jacket covered the barrel; another, part of the jacket surrounded the inlet port and cylinder head; the third, the jacket portion surrounded the exhaust port. Each of the three jackets had an inlet and outlet for cooling water.

The reduction in heat transferred to the exhaust port, on account of the shield, varied from 20 per cent at rich mixture to 13 per cent at lean mixtures. Theoretical calculations provided a basis for estimating possible savings of between 40 and 50 per cent. It was emphasized in the conclusions that it was not unreasonable to say that measured values of heat saved by the shield were not an accurate index of its worth, as difficulties in installing the shield rendered it much below its maximum effectiveness.

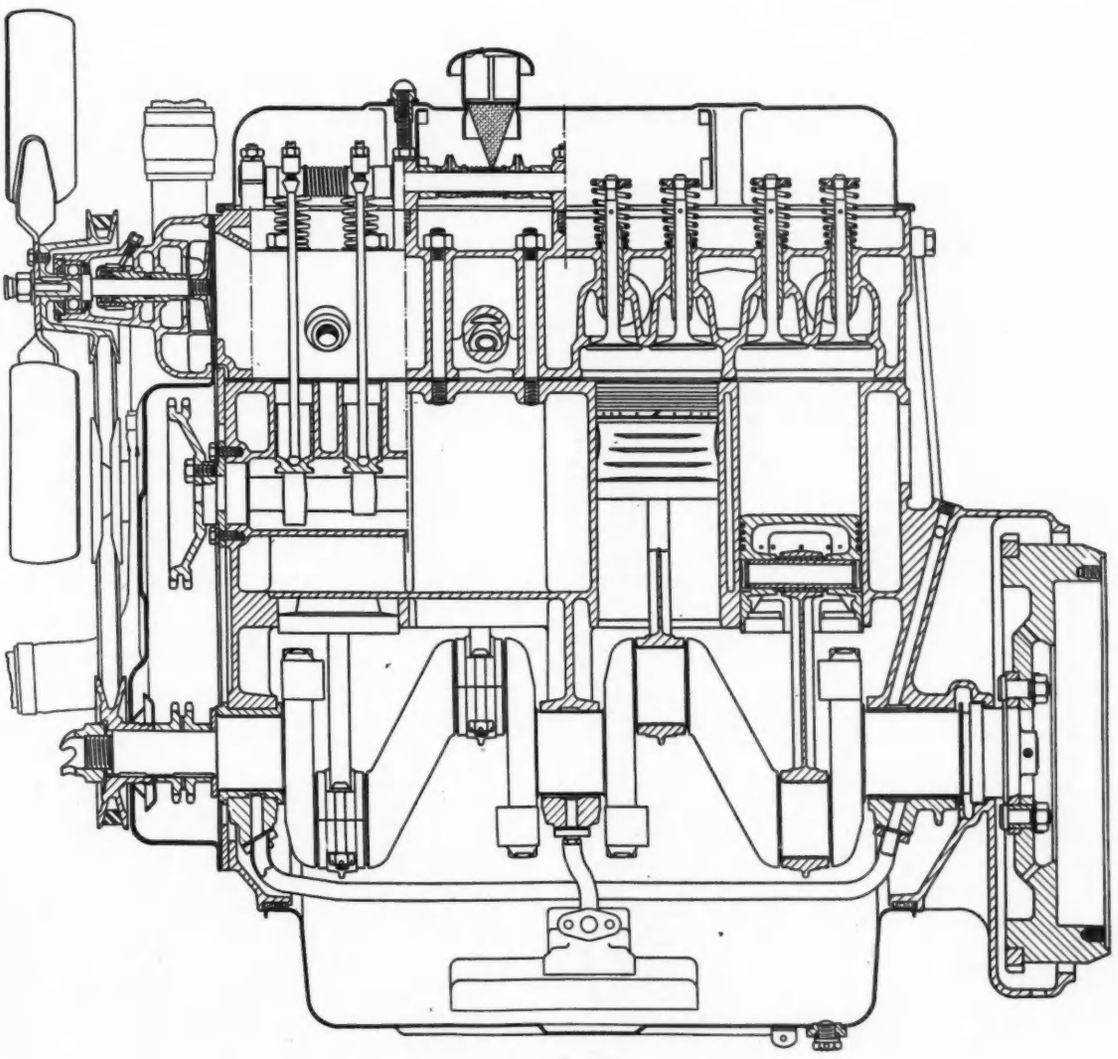
British Developing Two-Stroke Diesel for Aircraft

RESEARCH on Diesel engines for aviation purposes was largely confined to the two-stroke type during the past two years, according to the report of the Aeronautic Research Committee (Great Britain) for 1935-36. Ricardo & Co. have successfully built and tested a new type of sleeve valve which requires no sealing rings, the upper part of the sleeve being sufficiently thin to expand against the cylinder wall under the gas pressure. This modification, if successful, will be of considerable importance, because it permits of the use of a cylinder head of simpler design and easier to cool. It is stated that at the end of a 50-hour test the engine was in excellent condition, its pistons and rings being remarkably clean.

Ricardo & Co. also built for the Air Ministry a new two-stroke Diesel engine to determine the practicability of higher speeds. This engine can be run at speeds up to 2500 r.p.m. A high output was obtained, but various problems arose that call for further research. Development work is directed toward improving the scavenging, which apparently is not very good at present, and the view is expressed that if this should prove successful the output may be greatly increased. Theory indicates that if a high-pressure supercharger is developed, the output of the Diesel can be raised to that of the gasoline engine of equal size and weight. The Committee has recommended investigations on single-cylinder units of special design to obtain this information. Some work has been done already by Ricardo & Co., who have shown that no difficulty is likely to be encountered in starting and idling with a compression ratio as low as 9:1 if a high-compression supercharger is fitted.

PEUGEOT

This 4-cylinder passenger car engine is made by the Societe Anonyme des Automobiles Peugeot, Paris, France. Specification data on the model 402, which is reproduced herewith, are given on page 130.



No. 35 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

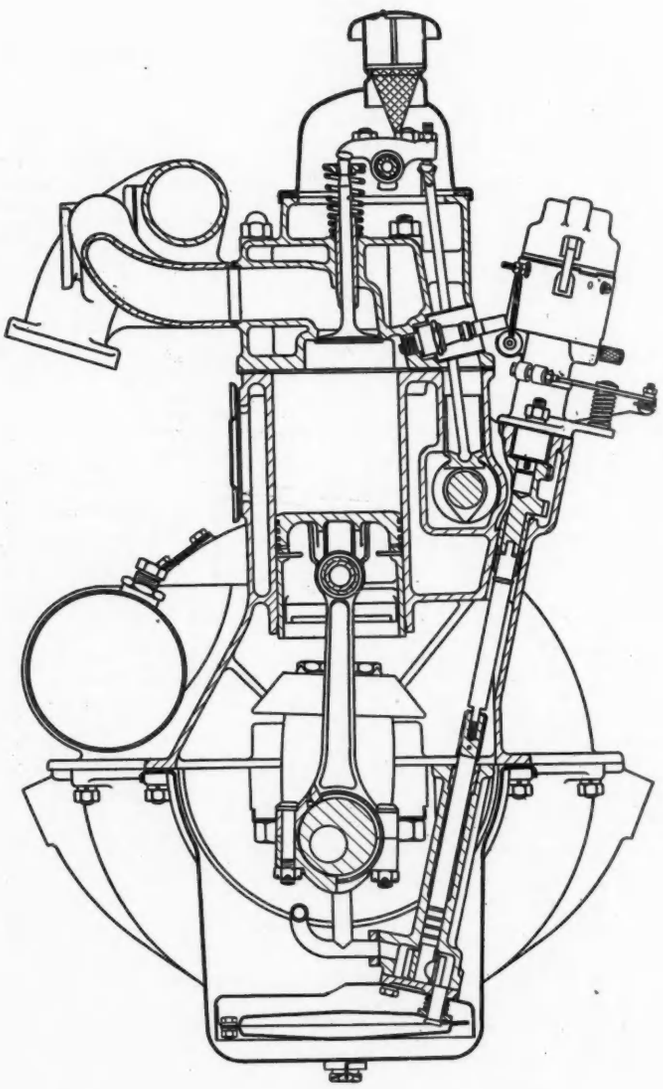
PEUGEOT

Bore and stroke dimensions of the 4-cylinder, model 402 Peugeot passenger car engine are 83 by 92 mm. (3.27 by 3.48 in.), giving a total piston displacement of 1991 cc. (122 cu. in.).

Horsepower rating of the unit is 58 at 4000 r.p.m. Compression ratio is 6 to 1.

The crankcase is cast integral with the cylinder block. Three main bearings support the crankshaft. The camshaft is chain driven. Valves are located in the cast iron cylinder head.

Aluminum pistons have four rings, three compression and one oil scraper. A downdraft carburetor is used



Vehicle Performance

(Continued from page 118)

reflects the personal viewpoint rather than a definite fact.

With regard to what is said relative to the manner in which a transmission can provide better economy or smoother running, the author is once more on solid ground and correct in his analysis.

Concerning the study of the different gear ratios provided in several transmissions of each type, I suppose there will always be differing opinions, and it is surprising that on the whole there is such a close agreement.

Believing, as I do, in the overgear box, I feel that the greater total spread between top and low gear and the smaller jump between 5th and 4th is an advantage. However, there certainly is no reason why this could not be done with equal facility in the direct gear box.

The shift pattern provided in some boxes is properly subject to criticism, but the one which is illustrated herewith has eliminated most if not all of this objection. The speed of the teeth may be greater, but need not be. As far as I know, in the direct gear boxes the sliding elements, whether gears or clutches, are on the mainshaft. This is also true in some over-gear boxes, and where this is so the author's statement is correct.

In illustration, if we take the equivalent boxes shown in the paper and assume a speed of 1000 r.p.m. for the pinion shaft with clutch tooth engagement, then we have speeds as below:

TABLE I

	Direct Box	Overgear Box
Gear	1,000	1,390
Clutch	720	1,000

However, several overgear boxes are made where the 5th speed idle gear and clutch are on the countershaft, and this reduces the speed of the engaging parts in the order of the ratio between the direct pinion and the countershaft as shown:

TABLE II

	Direct Box	Overgear Box
Gear	1,000	635
Clutch	720	457

This is the condition which would exist when running in 4th gear anticipating a change up into 5th. When running in 5th gear, the condition in both overgear boxes would be as shown in Table I.

A great many words could be written as to whether one or the other of these arrangements is better and how or why, but it would be a useless effort. Suffice it to say that I believe these figures give evidence that comparative results can be obtained with either set-up. It is granted, naturally, that drive shaft speeds are higher with the overgear box when both units are combined with the proper axle ratios. Also, admittedly, this increased speed makes greater demands on the driveshaft. These demands are met in modern construction and not entirely because of the higher speed requirements. Surely, any one familiar with the old type joints, with fabric, leather or other coverings containing grease which, if heavy enough to prevent splattering over everything, could by no stretch of the imagination have any lubricating value, will recognize the real reasons why this automotive unit has "been so suddenly and drastically overhauled and revamped."

Recognizing this phase of the problem there is surely no excuse for the statement: "Aside from the fact that the overgeared transmission offers no virtues peculiar to itself, there are effects from its use which are usually wholly ignored."

On the contrary I affirm the overgeared transmission has very definite "virtues peculiar to itself." Such a contradiction of the author's statement requires supporting information which I will endeavor to supply.

The difficult points in a transmission to properly provide for are the pocket bearing on the mainshaft and the first-speed pinion on the countershaft. In general I have accepted a total range of about 8:1 as a satisfactory spread in a five-gear box, and this agrees with the information tabulated in the paper. The author notes a box with a 10:1 spread, which can be done except that it would seem to call for rather large gear centers and consequent large diameter gears and relatively high tooth speeds, as well as, possibly, undesirably large jumps between gears. Assuming, as I must, that these difficulties have been overcome, there is no reason why the same result could not be had in an overgear box. Therefore whether the total reduction is 8:1 or 10:1 makes no difference in my discussion.

It should be obvious that if a direct gear box with an 8:1 low gear has the same gear centers as an over gear box with a 0.72:1 top gear and a 5.75 low gear, the tooth pressures will be about 40 per cent greater, requiring greater gear faces, heavier shafts and larger bearings. The alternative is to increase the gear centers, which means gears of larger diameter. So much for the one problem.

Regarding the pocket bearing, both the direct and overgear five-speed box contemplate two top gears, which will be used with equal facility and frequency. The fourth speed in each is the gear which must be used most often when loads are heavy or better acceleration is required, as in city traffic or in hilly country. However, even on the assumption that the 5th and 4th gear use is equal and comparable, it will be seen that in the direct gear box when running in 5th the pocket bearing carries no load while in the overgear box it is loaded on a basis of 72 per cent of engine torque. When running in 4th gear the pocket bearing in the direct gear box is loaded to 139 per cent of engine torque, while in the overgear box, 4th gear being direct, there is no load. In the other gears, which are indirect in both boxes, the pocket-bearing loading will again be approximately in the ratio of the low gear reduction, if the gear centers are the same. However, the fourth gear condition is the worst, for here the bearing carries a load nearly twice as great as is imposed on the bearing when the overdrive box is operating in 5th gear. At the same time, unless the gear centers are spread, the pinion diameter in the direct gear box does not afford as much room for an adequate bearing as the larger pinion in the overgear box does.

It is felt that this indicates that there is virtue in the overgear design and that a more correct statement is that, as in most design problems, each type has virtue but neither has a monopoly.

Relative to power losses arising from the churning of gears in the lubricant, the following data is submitted. This information resulted from tests made on a four-speed, direct-drive box and a five-speed overgear box. The gears were identical in both instances, the 5th speed being omitted in the four-gear box and the case being shorter by the amount of space required for these gears. The gear speeds were therefore the same.

TABLE III

Four Speed Box

Input Speeds	4th Gear	3rd Gear
2,400	4.3 hp.	3.2 hp.
2,000	3.4 "	2.5 "
1,600	2.4 "	1.8 "
1,200	1.5 "	1.2 "
800	0.8 "	0.6 "

Power required in four speed direct drive transmission to drive gears in lubricant 120 deg. F.

Gear oil viscosity at 100 deg. F., 1932 seconds; at 210 deg. F., 120 seconds.

TABLE IV

Five Speed Box

Input Speeds	5th Gear	4th Gear	3rd Gear
2,400	4.5 hp.	3.7 hp.	3.1 hp.
2,000	3.6 "	2.9 "	2.4 "
1,600	2.6 "	2.1 "	1.8 "
1,200	1.8 "	1.5 "	1.2 "
800	1.0 "	0.8 "	0.6 "

Power required in five-speed overgear transmission to drive gears in lubricant at 120 deg. F.

Gear oil viscosity at 100 deg. F., 1932 seconds; at 210 deg. F., 120 seconds.

Due to fact that the countershaft

speeds are the same in both instances, the data does not apply to the premises on which the author's statement is based. However, it does indicate that losses are not excessive. The question may arise as to why the losses are smaller in 4th and 3rd gear of the five-speed box. I believe this to be due to differences in bearing adjustment and gear fits.

I hardly feel that Mr. Horine is consistent in the statement made relative to the rear axle. In the earlier part of his paper he properly emphasizes that proper comparisons are only made on the basis of equal *output* torque from the rear axle. In this statement he says that for equal *input* torque the smaller pinion required in the slower-geared rear axle will be subjected to heavier tooth pressures. This is obviously an unwarranted change of position. His first statement is correct and under these conditions the difference in pinion diameters is in the same ratio as the input torque and gives equal *output* torque and tooth loading.

Catalin Offers New Type Molding Resins

Catalin Corp., New York, has announced the addition to its line of cast resins, an entirely new type of molding resin. It has virtually the same properties as the cast form and is available in the same colors, ranging from the water-white form, termed "Prystal," and delicate transparent shades, to vivid colors available in transparent, translucent and opaque forms.

The new form of Catalin is molded in the same way as ordinary filled phenolic compounds and like them is thermo-setting, that is, it is permanently hardened by the molding process and cannot be softened by subsequent heating. It will thus be available for molding knobs and trim for automotive as well as for other applications, and in transparent and translucent effects heretofore available (except in machined form) only in thermo-plastic materials. The latter require cooling in the mold whereas Catalin of the new type is formed in molds kept permanently hot throughout the molding cycle of three to five minutes. Physical properties are reported about the same as other molding phenolics and the same molds can be used except that, especially for transparent colors, chromium plating of the mold is recommended. Or the mold can be made from stainless steel.

Molding is done at a temperature of 270 to 300 deg. Fahr. and under a pressure of 1500 to 3000 lb. per sq. in., both the temperature and pressure being somewhat lower than for molding the common form of phenolics.

Pros and Cons of Streamlined Passenger Cars

Marked differences of opinion cropped up in the discussion of a paper on "Design of Motor Cars" read by Cecil Kimber before the Design and Industries Association in London recently. Mr. Kimber expressed the view, in broad terms, that the streamline form represented the nearest approach to the ideal, and envisaged a design that would be effectively streamlined in both elevation and plan. As regards present designs, he expressed a marked preference for those exhibiting continuity of line, and instanced the latest M.G. model as an example in which a good compromise between utility and pleasing lines had been secured.

The general feeling of the majority of those taking part in the discussion appeared to be that the streamline form, while no doubt desirable at some future date when speeds on the roads might be much higher than at present, was on the whole unsuitable for the

conditions ruling today. One speaker obtained wide support for the contention that if a touring car were designed essentially from the point of view of best fulfilling the object for which it was intended, that is for the transport of human beings on the road with the highest practicable degree of comfort and safety, the streamline form could not be justified. Quite apart from its mechanical performance, the most desirable attributes for a car were clear vision, particularly for the driver, ample head room, adequate accommodation for luggage of conventional shape, and with the seating accommodation arranged to give the highest practicable degree of comfort.

The general feeling of the meeting appeared to be that these desiderata could not be secured with the streamline form without the imposition of needless weight and bulk. In general, no objection was taken to the application of streamlining in so far as it was limited to the elimination of unnecessary breaks in contour, such as occurred, for example, in the older rectangular body forms with a variety of needless excrescences, but the retention of false fittings, such as driving hood stretchers, to give continuity of line between the top of the window frame and the top of the rear mudguard, advocated by the author of the paper, was somewhat severely criticized.—*Engineering.*

Beyond the Near Future

(Continued from page 105)

how to do the job.

"Size of passenger cars will largely be determined by the space required to house the passengers. Probably this will not change very much. Road clearances of a little under 8 inches have been common for a number of years and it would seem that nothing now being developed would reduce this figure. Lower door clearances are apparently here to stay.

"A rear-engined car would provide better visibility with clear vision directly ahead. It would probably eliminate much engine noise, heat and odors, and allow lower floor boards. However, maneuverability, particularly cornering, requires an almost equal distribution of weight on the front and rear wheels. To accomplish this in a rear-engined car of reasonable wheelbase will require an engine of about half the weight of the present units.

"The trend in tire development is toward improvements in compounding technique that will result in more heat resisting rubber compounds. Some of the new tires show the results of this work in their improvement from the standpoint of carcass failure and blowouts, particularly where trucks and buses are operated at high speed under heavy load.

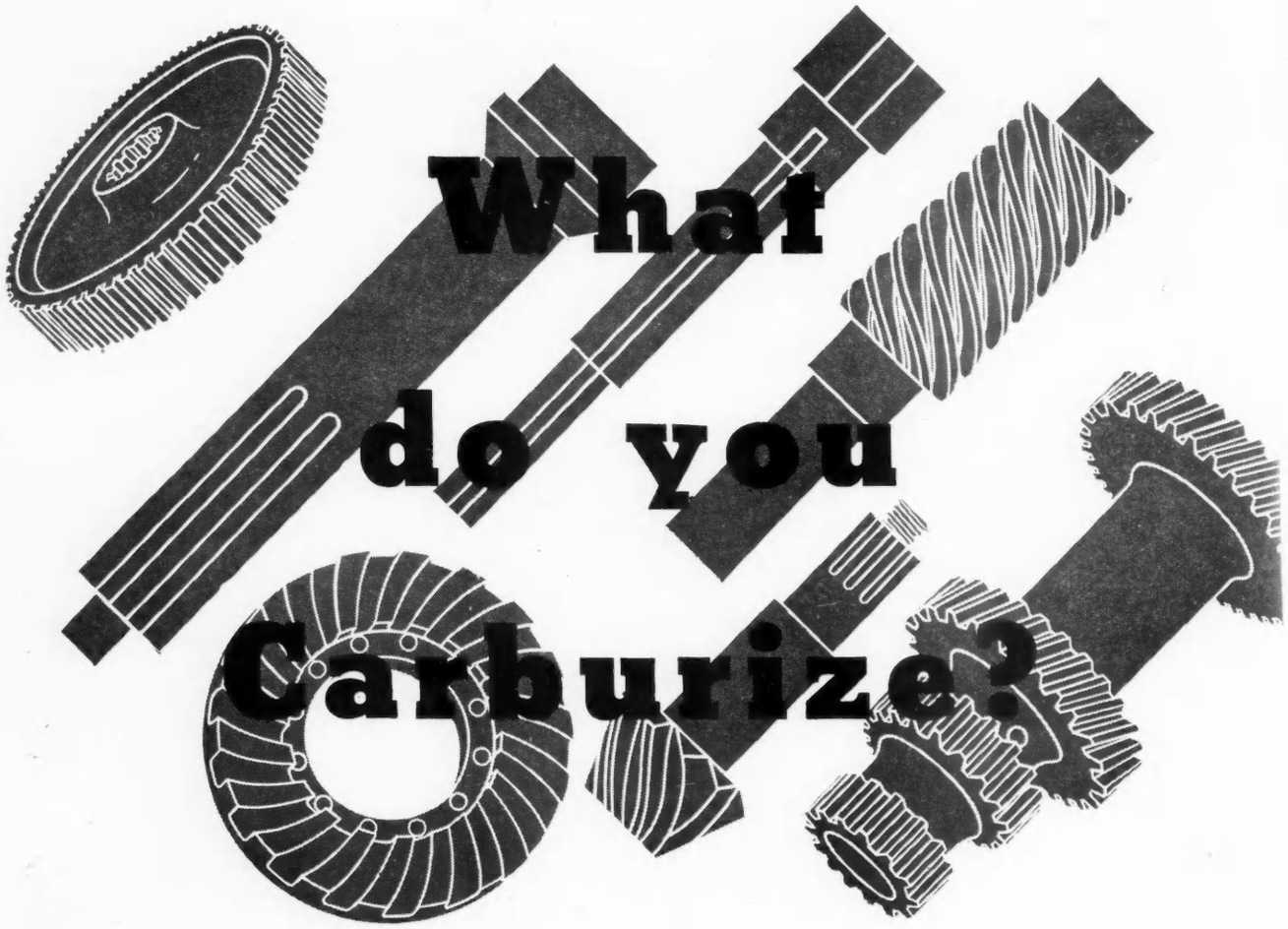
"Many surveys have shown that the average speed is less than 45 m.p.h. on good roads and only a few per cent travel as fast as 60 m.p.h. Automatic devices which limit speed or take the control away from the driver may be the cause of accidents.

"For some time to come it looks like we are going to have to provide our illumination on most of our roads from the automobile itself. To obtain good vision without glare is our problem.

"The related problem of visibility, front and rear, from the driver's seat is an important subject. . . . Narrower front pillars, better seat positions, glass angles, and locations to eliminate reflection, sun glare shields, front end shape and many other considerations are involved.

"There will be a great expansion in the use of trucks and buses. The trend seems to be toward many more, smaller, faster, more mobile units.

". . . . the highway of the future must be as different from the present highway as the automobile of the future will be from the present automobile. Of one thing we can always be sure: the future will demand change."



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